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"INSECTAE PORTORICENSIS."

A PRELIMINARY ANNOTATED CHECK-LIST OF THE INSECTS OF PORTO RICO, WITH DESCRIPTIONS OF SOME NEWS SPECIES.

BY

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INTRODUCTION.

The earliest recorded collection of insects in Porto Rico was made by Andres Pedro Ledru and is reported in his "Viaje a la Isla de Puerto Rico en el Año 1797," Paris, 1810. Of the forty-six insects listed from Porto Rico under their scientific names, ten can be readily identified:

Termes morio Fabr. =	*Nasutitermes morio* Latreille
Blatta americana L. =	*Periplaneta americana* Linn.
Grillus assimilis Fabr. =	*Grillus assimilis* Fabr.
Achaeta grillotalpa Fab. =	*Scapteriscus vicinus* Scudder
Cimex victor Fabr. =	*Proxys victor* Fabr.
Pulex penetrans Linn. =	*Dermatophilus penetrans* Linn.
Elater phosphoreus F. =	*Pyrophorus luminosus* Illiger
Passalus pentaphyllus Latreille =	*Passalus pentaphyllus* Latreille
Scarabaeus tytanus Fab. =	*Strataegus titanus* Fabr.
Bember signata Linn. =	*Stictia signata* Linn.

and one can guess at the probable identity of many of the others. Considering the time when Ledru wrote, the incompleteness of his list is not surprising, and as he lists many more species than are named, and does not omit mention of smaller and less obvious forms, such as ichneumons and ants, its real importance should not be underestimated, even though its value is mainly historic.

In 1882, Dr. Augustin Stahl of Bayamón, P. R. had published at San Juan his "Fauna de Puerto Rico," pages 82 to 102 being devoted to a discussion of the systematic classification of insects, and pages 169 to 249 to a list of specimens from Cuba, Trinidad and Porto Rico in his collection at Bayamón. Copies of his paper are now rare, and little is left of his collection, although it is reported that fragments of it still exist.

For a considerable number of years before the appearance of Stahl's paper, the German consul stationed at Mayagüez, Herr D. Leopoldo Krug, had been collecting insects, and at his instance the

eminent naturalist, Dr. Juan Gundlach, made two trips to Porto Rico, and together they collected at Mayagüez and in various other parts of the Island. Their collections were sent to Berlin, where they were studied, classified and the many new species described by various specialists. Between May 1887 and September 1893, Gundlach published the sections dealing with insects of his "Fauna Porto Ricqueña" in the Anales de la Sociedad Española de Historia Natural, Madrid, embodying the results of their work. Herr H. J. Kolbe identified their specimens of Neuroptera, described the new species and listed the entire collection. Dr. Henri de Saussure identified the Orthoptera, but at the time Gundlach published, he did not know whether Saussure had published the descriptions of the new species, the manuscript names for which he gives. Dr. Uhler identified the Hemiptera, but apparently did not publish descriptions of the new species from Porto Rico, and Gundlach notes only a few Homoptera, as Dr. Uhler identified them only to genus. Although various specialists in small groups of Coleoptera, especially Herr. G. Quedenfeldt and Herr. J. Weise, identified or described new species from Porto Rico, a number of large and common species peculiar to Porto Rico, notably the *Lachnosterna*, are not even mentioned by Gundlach because he could not get them determined or described. Herr. Victor Von Roeder identified the Diptera, listing and redescribing about eighty species and describing eleven new species. Dr. H. Dewitz identified the Hymenoptera, excepting the ants, and described many new species. He also listed the butterflies collected in Porto Rico, and described and listed some of the moths. He was unable to work up the entire collection of Lepidoptera, which was turned over to Herr. H. B. Möschler, whose extensive paper, containing descriptions of many new species, was published posthumously by Herr. M. Saalmüller. Gundlach's paper will remain a lasting monument to his energy, perseverance and industry in advancing systematic entomology in Porto Rico.

Since Gundlach's time, various workers from the United States have supplemented portions of his list. Dr. D. W. Coquillett in the Diptera, Prof. Wm. M. Wheeler in the Formicidæ, Mr. Thos. H. Jones in the Coccidæ, Mr. J. A. G. Rehn in the Orthoptera, Messrs. Leng and Mutchler in the Coleoptera, and Dr. Nathan Banks in the Isoptera, have published important papers.

In 1914, Mr. R. H. Van Zwaluwenburg prepared a list of all determinations of insects in the collections at the two experiment stations, giving the number of the note or determination and the

host records of those at the Mayagüez (Federal) Station, of which he was at that time Entomologist. He also listed all those recorded in the literature which was available to him, but unfortunately he had neither Stahl's nor Gundlach's papers His list was never published, but typewritten copies, together with a supplement of 15 pages, March 1915, were presented to a small number of persons or institutions especially interested

Important advances in Entomology since the change in government in 1898 have been made in the economic field by workers at the two Experiment Stations. Since 1903, the reports of the Federal Experiment Station at Mayagüez, and a few papers devoted largely or entirely to Entomology, have contained references to many insects from an economic standpoint. Mr. O. W. Barrett was Entomologist and Botanist there from 1903 to 1905; Mr. W. V. Tower, Entomologist from 1906 to 1911, and from 1917 to the present time, Dr. C. W. Hooker in 1912, and Mr. R. H. Van Zwaluwenburg from 1914 to 1917.

With the establishment of the experiment station of the Sugar Producers' Association in 1910, an intensive study of the insect pests of sugar cane has been made, the results of which have appeared as annual reports, lists of the insect pests of sugar cane, and as bulletins or circulars of a single insect, or group of insects. Following the transfer of the station to the Insular Government, the field of entomological investigation was broadened to include all economic insects, and a great diversity of publications has appeared.

The present list is an attempt to summarize the records in literature of the occurence of the insects in Porto Rico, together with the records of the collections at the two experiment stations; that at Mayagüez as given by Van Zwaluwenburg in his list, which includes a number, prefixed by "P. R." if considered not of economic importance, and often host records, but with locality, usually Mayagüez or vicinity, and collector unspecified; that at Río Piedras with host and locality records (Río Piedras always implied if not specified), accession numbers or collector's initials and sometimes other data.

Mr. D. L. Van Dine, the first Entomologist at the Río Piedras Station, collected all the insects, mostly from sugar cane, with accession numbers of the years 1910 and 1911 (ending in —10 or —11). Mr. Thomas H. Jones collected most of the insects listed in

1912, and those numbered from 1 to 499, 700 to 999, and 1201 to 1299 in 1913; 1 to 100 and 701 to 898 in 1914, although Mr. Van Dine made a number of collections in 1912 and a few in 1913. Mr. E. G. Smyth collected, usually at light at Guánica, those listed under 500 to 699 and 1000 to 1199 in 1913; and at Mona Island or other localities those under 1300 to 1399 in 1913; at Guánica those under 500 to 699 in 1914 and under 200 to 999 in 1915; at Río Piedras many in 1916 and most of those in 1918, 1919 and 1920. Mr. G. N. Wolcott was responsible for a few collections in 1914, those between 1 and 190 in 1915, some in 1916 and many in 1921 and 1922. Mr. R. T. Cotton collected many of the insects, especially those in citrus groves, listed in 1916 and practically all in 1917. Messrs. R. A. Crespo, E. Nelson and L. A. Catoni collected a few of the insects listed in 1918, 1919 and 1920. Mr. J. D. More collected a few insects in 1920, and those, mostly insects of cotton, or ants, under 500 to 625 in 1921 and 1922. Mr. Francisco Seín collected many insects, mostly from coffee, in 1921 and 1922.

Mr. S. S. Crossman collected some insects, mostly on tobacco or at light at Aibonito, unaccessioned, but followed by his initials (SSC) and Mr. G. B. Merrill those followed by his initials. The records followed by the initials of other entomologists represent unaccessioned specimens or field notes. The records of unlabeled specimens bear their own mute testimony to the anonymity of their collectors, but, so far as the writer is aware, Mr. Van Dine and Mr. Jones never failed to label their specimens

Commas are used to separate the data differing in only one particular of host or locality, semicolons that differing in both host and locality, and often periods to separate the records of adult, larva and egg. Records of collections at Río Piedras are placed first and this locality is implied when none is specified.

The references to the lists of Stahl, Gundlach and the specialists who identified and listed his collections, of Van Zwaluwenburg, of Leng & Mutchler, and to the more extensive systematic papers, are given merely as the name, or initial, of the writer; those to other references by author, with the year of publication and page separated by a dash. When the insect was listed under another genus, or in synonymy, or incorrectly, the name under which it was listed is usually given before that of the authority for the record, and applies to all references on the same line or in the same paragraph.

All records, whether verified by later collections and determina-

tions, or not, have been included, but the more doubtful have been enclosed in brackets. Manuscript names given by Stahl and Gundlach are included, as some of them have been validated by publication of descriptions long after the appearance of their lists.

In 1914, several entomologists from the American Museum of Natural History, New York City, collected insects in Porto Rico, and some of the larger and more common specimens of their collections were returned as a named collection, placed first in the University of Porto Rico, later at the Insular Experiment Station, and at present what remains of the collection is in the Museum at San Juan. From a list of these specimens, made by the writer at the time of their transfer to the Station, the "AMNH" records in this list are taken.

The system of classification and the arrangement of species listed is partly accidental, and is admittedly uneven and inconsistent. In orders where inclusive lists were available, these have been followed, but for some of the smaller groups, the order of species given by Gundlach has been used.

To Dr. L. O. Howard, Chief of the Bureau of Entomology, the writer is most greatly indebted for making the preparation of this list possible, by obtaining from the specialists in the Bureau and in the National Museum the determination of specimens, and by authorizing personal consultation with these gentlemen. Not only did they determine specimens, but in some cases they revised the first draft of the section of the check-list which was submitted to them, in many cases adding new records, of specimens or from literature not available to the writer, and to each of them he is under deep obligation. In the paragraph preceding each order is given the names of the specialist, or specialists, who have determined specimens of insects of that order. In the body of the list, if this is the first record of the insect in Porto Rico, the name of the specialist making the determination is given immediately after the name of the insect and on the same line with it. If the insect was described from Porto Rico, the reference to the original description is given if known, followed by "TYPE from Porto Rico." But if the insect has been previously recorded, the name of the specialist making the determination of specimens from the collection of the Insular Station is usually given with the accession number of the particular specimen which he determined, and it does *not* refer to the determination of the host.

Mr. John R. Johnston, the first Plant Pathologist at the Río Piedras Station identified many of the plants on which Mr. Van Dine and Mr. Jones found insects feeding. But it is to his successor, Mr. John A. Stevenson, to whom the Entomological Department is most greatly indebted for such identifications, not only while he was in Porto Rico, but even after leaving the Island. Both of these gentlemen collected, in addition, a considerable number of insects. Mr. Carlos E. Chardón and Dr. N. L. Britton have also determined some host plants.

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THYSANURA.

LEPISMIDÆ.

Ctenolepisma reducta Folsom, J. W., "A New Lepismid from Porto Rico" *in* Proc. Ent. Soc. Washington, Vol. 25, No. 7–8, Oct.–Nov., 1923, pp. 169–170, (Plate 14, figs. 1–8.): TYPE from Porto Rico.

from envelopes of scale-insect collection (65–23), common in libraries and with stored papers; possibly this species in dry cactus at Boquerón (GNW).

ORTHOPTERA.

LITERATURE.

Burr, Malcom, "Dermaptera (Earwigs) of the U. S. National Museum" Proc. U. S. Nat. Mus., Vol. 38, No. 1760, pp. 443–467, August 20, 1910, Washington, D. C.

Rehn, James, A. G., "Notes on West Indian Orthoptera, with a List of the Species known from the Island of Porto Rico." Trans. Amer. Ent. Soc., Vol. 29, pp. 129–136, April 4, 1903.

Rehn, James, A. G., "On Some Orthoptera from Porto Rico, Culebra and Vieques Islands." Bull. Amer. Mus. Nat. Hist., Vol. 28, Art. 7, pp. 73–77, March 22, 1910.

Seín, Francisco, "Cucarachas." Circular 64, Insular Experiment Station, Río Piedras, P. R., pp. 1–12, fig. 9, April 28, 1923.

The original records in the following list of Orthoptera are based mostly on material determined by Mr. A. N. Caudell. To him the writer is also much indebted for records of specimens in the National Museum which were collected in Porto Rico, and for bibliographic references to literature not available in Porto Rico.

FORFICULIDÆ.

Anisolabis ambigua Borelli
(as *Borellia janierensis* Dohrn) Burr 10–448.
from young plant cane in the ground (443–12), from dead seed-cane in the ground at Fajardo (232–12).

Anisolabis annulipes Lucas
Burr 10–447.

Anisolabis maritima Géné
Burr 10–448.

Anisolabis minuta Caudell, A. N. (as *Borellia*), Jour. N. Y. Ent. Soc., .Vol. 15, p. 168, 1907, TYPE from Porto Rico.
Burr 10–448.

Labia curvicauda Motschler
Wolcott 21–13: under leaf-sheaths of sugar cane.
on coconut at San Lorenzo (12–21); under leaf-sheath of sugar cane at Mameyes (GNW).

Labia dorsalis Burmeister
abundant under bark of dead bucare tree, *Erythrina glauca,* at Cayey (305–17).

Prolabia unidentata Palisot de Beauvois (Brachypterous form).
under bark of dead bucare tree, *Erythrina glauca,* at Cayey (306–17, GNW), under banana plants at Cayey (19–21).

Labidura bidens Olivier
(as *L. riparia* Pall.) Gundlach, "se encuentra debajo de las cortezas sueltas de los árboles muertos."
(as *L. dufouri* Desm. = *L. pallipes* Duf.) Gundlach, "debajo de las cortezas sueltas."
(as *L. riparia* Pall.) Burr 10–451.

Doru albipes Fabricius
(as *Phaulex*) Van Z. (P. R. 1).
Wetmore 16–62, 116: eaten by Woodpecker and Oriole.
legs yellow and with large yellow spots at base and apex of tegmina: on sugar cane (142–21), at Guánica (142–21); in cotton square at Pt. Cangrejos (548–22); under board in garden at Guánica (EGS).

Psalis americana var. **gagathina** Burmeister, G., Handbuch der Entomologie, Vol. 2, p. 753, 1838, Berlin, TYPE from Porto Rico. (= *P. buscki* Rehn).
Gundlach. Burr 10–446. Van Z. (P. R. 2).
under bark of decaying bucare tree, *Erythrina glauca,* at Cayey, ovipositing (247–17); on El Duque (elev. 1600 ft.) at Naguabo (726–14); under banana plants at Vega Baja (277–22).

BLATTIDÆ.

Ceratinoptera diaphana Fabricius
Rehn 10–73: from Culebra Island. AMNH at Tallaboa.
Seín 23–10: "under bark of trees, in abandoned cocoons of the 'plumilla' (*Megalopyge krugii* Dewitz), also in leaves webbed together by caterpillars and in abandoned spider nests." Illustration of adult.
on rotten wood fence at Pt. Salinas (131–15); in empty cocoons of *Megalopyge krugii* Dewitz on trunks of bucare trees, *Erythrina glauca,* at Cayey (300–17); on trunk of *Inga laurina* at Ciales (463–21), at Adjuntas (270–22), at Lares (100–22); in larval tents of *Tetralopha scabridella* Ragonot on *Inga vera* at Lares (101–22, 151–22).

Latiblattella vitrea Brunner
(as *Blatta vitrea* Burm.) Gundlach.

Neoblattella adspersicollis Stal
(possibly the *Blatta (Phyllodromia) caribaea* Saussure MS listed by Gundlach).
Rehn, James, A. G., "The Orthoptera of the Bahamas" *in* Bull. Amer. Mus. Nat. Hist., Vol. 22, Art. 5, p. 110, May 23, 1906, footnote: "This is the species recorded by me as *B. punctulata* from Porto Rico (Trans. Amer. Ent. Soc. XXIX, p. 130) and *B. azteca* from Porto Rico and Jamaica (*Ibid.*, XXIX, p. 268)."

Supella supellectilum Serville
(as *Blatta*) Gundlach, "encontrado en las casas; Mayagüez."
Seín 23–8: in houses, with *Blattella germanica* Linn.
in house at Condado (498–21, 139–22), at Lares (637–21, 102–22); in hotel at Arecibo (112A–22).

Cariblatta punctulata Palisot de Beauvois
(as *Blatta delicatula* Guerin) Gundlach, "viene muchas veces por la noche a las casas, atraída por la luz." Stahl.
(as *Blatella*) Van Z. (P. R. 7).
(as *Neoblattella*) AMNH at Arecibo and Aibonito.
(as *Blatella*) Seín 23–11: "between the leaves of sugar cane and corn, probably feeding on the excrement of caterpillars and beetles."
(189–22), under leaf-sheaths of sugar-cane (200–11, 210–11), at San Vicente (903–14), at Arecibo (16–15), at Guánica (504½–13); under leaf-sheaths of corn possibly feeding on excrement of *Laphygma frugiperda* S. & A. (450–17, 548–17).

Blattella germanica Linnaeus
(as *Blatta*) Gundlach.
(? as *Ectobia germania* ?) Van Z. (P. R. 1723).
Seín 23–7: as a pest in houses, even when kept clean: life-history and illustrations of all stages.
in house at Condado (489–21, 135–22).

Blattella sp. — det. Caudell
on coffee leaves (172–21), in flower pot (137–22); on sugar cane at Arecibo (634–21).

Pelmatosilpha coriacea Rehn, J. A. G., "Studies in American Blattidae" Trans. Amer. Ent. Soc., Vol. 29, p. 273, September 1903, TYPE from Porto Rico.
on sugar cane (4–15), on bananas at the market (87–23).

Nauphoeta cinerea Olivier
Stahl.

Epilampra wheeleri Rehn 10–73, TYPE from Utuado, Porto Rico.
(as sp.) Wetmore 16–69: eaten by Owl, *Gymnasio nudipes.*
Seín 23–11: "abundant in malojillo meadows": notes and illustration of adult.
under dead leaves in wet malojillo, *Panicum barbinode,* meadow (187–22).

Ischnoptera adusta Caudell, A. N., Canadian Entomologist, Vol. 37, p. 237, 1905, TYPE from Porto Rico.

Ischnoptera blattoides Saussure
Gundlach, "durante el día escondida en las casas."

Ischnoptera rufa DeGeer
Brunner, v. W. C., "Nouveau Systeme de Blattaires", 1865, p. 131.
(as *I. rufescens* Beauvois) Rehn 10–73: from Culebra Island.

Symploce capitata Saussure
(as *Blatta*) Stahl.

Symploce flagellata Hebard, Morgan, "Studies in the Group Ischnopterites" Trans. Amer. Ent. Soc., Vol. 42, p. 367, pl. xxiii, figs. 14–17, 1916, TYPE from Porto Rico.
on sugar cane (907A–14), at Martin Peña (GNW).

Nyctibora laevigata Palisot de Beauvois
(as *Phoetalia*) Rehn 10–73: from Utuado.

Nyctibora sp. nov. — det. Caudell
in rotten tree trunk, accompanied by *Eutermes morio* Latr., large yellow ants and *Strataegus* grubs, at San Sebastián (96–21).

Periplaneta americana Linnaeus
(as *Blatta*) Ledru 1780.
Stahl. Gundlach, "en las casas." Seín 23–4: an extended account, life-history, parasites and illustrations of adult and eggs.
in the house (309–12, 799–14, 1044–16).

Periplaneta australiae Fabricius
Gundlach, "Se encuentra como plaga en las casas. De día está escondida y de noche sale; corre muy pronto y vuela."
Rehn 10–75: on Culebra Island.
Seín 23–7: notes and illustrations of adults and nymph.
in the house (4–13, 798–14).

Periplaneta brunnea Burmeister
Rehn 10–75: on Culebra Island. Seín 23–6: notes.
in the house (797–14, 83–18, 190–22, 274–22).

Leucophaea maderae Fabricius
(as *Panchlora*) Stahl.
Gundlach, "Vive como *P. surinamensis* Linn."
Rehn 10–75: from Culebra Island.
Seín 23–8: "la Cucaracha Fatula": an extended account and illustration of the adult.
in the house (322–12, 744–14, 1007–16, 45–18, 14–20), among stored papers (442–19), on the porch (179–12, 382–12), in the storeroom, eating bananas (169–21), very abundant in fruit store, especially in room where bananas are ripened, over a bushel having been killed by the proprietor (411–21, 425–21).

Pycnoscelus surinamensis Linnaeus.
(as *Panchlora indica* Fabr.) Stahl. (as *Panchlora*) Gundlach, "vive debajo de las piedras, tablas, etc.; también en las casas, en tierra."
(as *Leucophaea*) Wetmore 16–63: eaten by Woodpecker, *Melanerpes portoricensis*.
Seín 23–11: notes. Van Z. (P. R. 68).
in box of books (874–14), in earth in box (404–12); in earth in outdoor rearing cage at Guánica (400–14, 409–14); under flower pots in garden at Lares (103–22, 150–22); under dry cow dung at Boquerón (86–23).

Anaplecta dorsalis Brunner, von W. C., "Nouveau systeme des Blattaires" Vienne, 1865, p. 63, TYPE from Porto Rico.

Panchlora cubensis Saussure — det. as *P. nivea* Linn. by Mr. Caudell, but Mr. Rehn writes: "*Panchlora nivea* is not a West Indian species as far as we know today."
(as *P. nivea* Linn.) Gundlach, "Vive debajo de las cortezas sueltas de los árboles muertos, o debajo de las piedras, tablas, etc."
(as *P. hyalina* Sausurre) Rehn 03–285.
(as *P. nivea* Linn.) Seín 23–12: common in rotten coconut palm, viviparous, nymphs are brown and become the green adults in 100 days.
(413–16), in rotten interior of coconut palm by Laguna de Quiñones (258–16); (282–22, 419–22) reared adults from two females, one from rotten palm at Loíza, other from bananas.

Panchlora exoleta Burmeister
Rehn 03–131.

Panchlora peruana Saussure
Van Z. (P. R. 75).

Panchlora virescens Thunberg
Rehn 03–131.

Panchlora viridis Fabricius
Gundlach.

Blaberus cubensis Saussure
Van Z. (P. R. 43).

Blaberus discoidalis Serville
(as *B. rufescens* Sauss. — Zehntner) Rehn 03–131.
Seín 23–12: notes and illustration of adult.
(910–14, 424–21), in banana ripening room in fruit store (411–21).

Hemiblabera brunneri Saussure
Saussure — Zehntner. Biología Centrali–Americana, Orthoptera, Vol. 1, p. 122, 1894.

Hemiblabera manca Saussure, H., Soc. Ent., Vol. 8, p. 68, 1893, Zurich, TYPE from Porto Rico.
Rehn 10–76: from Fajardo and Culebra Island.

Holocompsa nitidula Fabricius
(as *H. collaris* Burm. and *H. cyanea* Burm., not in synonymy) Gundlach, "en las casas debajo de las tablas y otros objetos."

Plectoptera poeyi Saussure
Wetmore 16–66: eaten by Tody, *Todus mexicanus.*

Plectoptera porcellana Saussure
Gundlach, "Vive debajo de las cortezas sueltas de árboles muertos y vuela de noche a veces a las casas atraída por la luz."
Van Z. (P. R. 9). Seín 23–12: notes.
(278–12), on *Psidium guajava* (305–16), on *Spondias lutea* (726–16), on grapefruit trees (459–16), at Vega Alta (47–17, 211–17); on coffee trees (79–21), at Ciales (67–21); on sugar cane at Fajardo (903–14); in caterpillar nests of *Tetralopha scabridella* Ragonot on *Inga vera* at Lares (100–22, 152–22).

Plectoptera krugii Saussure, H., Biología Centrali-Americana, Orthoptera, Vol. 1, p. 85, 1893, TYPE from Porto Rico.
Gundlach.

Plectoptera unicolor Burmeister
Gundlach.

MANTIDÆ.

Gonatista grisea Fabr.
(as *G. cubensis* Saussure) Stahl.
Gundlach, "sobre los arbustos en la maleza y monte."
Van Z. (P. R. 12).
in grapefruit grove (458–16); at light at Guánica (479–14); nymph resting on trunk of coffee tree at Lares (312–22 — det. GNW).

Gonatista reticulata Thunberg
Caudell, A. N., Psyche, Vol. 19, No. 5, pp. 160–162, 1912.

Callimantis antillarum Saussure
(as *Iris*) Stahl. Gundlach, "encima de la hierba de guinea en Mayagüez."
Wetmore 16–58, 61, 77: eaten by Mangrove Cuckoo, Ani and Kingbird.
resting on small tree, *Inga laurina*, at Lares (145–22 — det. GNW).

PHASMIDÆ.

Dyme haita Westwood = **Bacunulus dryas** Westw.
in coffee grove at Lares (179–22).

Dyme krugiana Brunner, von W. C., Die Ins. Fam. der Phasmiden, p. 324, 1907, TYPE from Porto Rico.

Dyme (Bacteria) yersiniana Saussure H., "Phasmidarum species novae non nullae", Rev. Mag. Zool., (2) Vol. 20, p. 65, 1868, TYPE from Porto Rico.
Gundlach, "en los montes o malezas".

Bacteria calamus Fabr.
Haan, de Willem, "Bijdragen tot de Kennis der Orthoptera" *in* Verhand, de Natur. Gesch. der Nederl. Overzeesch, Bezitt. etc., Orthoptera. p. 102, 1842, Leiden.

Lamponius bocki Redtenbacker, J., "Die Ins. Fam. der Phasmiden," p. 357, 1908, TYPE from Mona Island.

Lamponius guerinii Saussure
(as *Pygirhychus*) Gundlach, "Hemos cogido solamente una larva."

Diapherodes longiscapha Redtenbacker 08–435, TYPE from Porto Rico.

Diapherodes (**gigas** Drury) **gigantea** Gmelin.
"occurs in Porto Rico" Caudell.

Diapherodes krugii Saussure MS name, TYPE from Porto Rico.
Gundlach, "en Mayagüez."

Aplopus achalus Rehn, J. A. G., Proc. Acad. Nat. Sci., Philadelphia, p. 68, 1904, TYPE from Porto Rico.
Wetmore 16–58: eaten by Mangrove Cuckoo, *Coccyzus minor mesiotes*.
Redtenbacher 08– : possibly synonymous with *A. jamaicensis* Drury.

Aplopus micropterus Lep. & Serv.
Haan 42–102 and 128.

Aplopus jamaicensis Drury
on *Inga laurina* at Lares (104–22).

Phibalosoma ceratocephalum Gray
(as *Acanthoderus (Xylodus) adumbratus* Saussure, H., Orth. Nov., Rev. Mag. Zool., p. 62, 1859, — synonymy by Redtenbacher. TYPE from Porto Rico) Gundlach, "en Mayagüez."

Canuleius cornutus Burmeister
Haan 42–102.

Clonistria linearis Drury
Redtenbacher 08–

TETRIGIDÆ (ACRYDIIDÆ).

Paratettix frey-gessneri Bolivar
Van Z. (P. R. 8).
on malojillo grass, *Panicum barbinode,* at Pt. Cangrejos (191–22); at light (143–15, 334–21).

Tettix caudata Saussure
Gundlach, "en parajes húmedos, v. gr. al lado de lagunas."

ACRIDIDÆ (LOCUSTIDÆ).

Sphinogonotus haitensis Saussure
Smyth 19–136: on sugar cane.
at light at Guánica (587–13) and up in the hills (137–15); on sandy waste land at Algarrobo (760–14).

Orpulella punctata DeGeer
Van Z. (det. Caudell).
in garden at Guánica (428–14, 461–14, 462–14).

Plectrotettix gregarius Saussure
Van Dine 13–35: eating leaves of sugar cane. Colón 19–58.
Wetmore 16–22, 61, (as sp.) 91: eaten by Cuban Green Heron, Ani and Mocking Bird.
Smyth 19–136: on sugar cane. Cotton 18–280: on beans.
(as *Stenobothrus*) Gundlach.
(as *Scyllina*) AMNH at San Juan and Mayagüez.
on sugar cane (338–12, 741–12, 206–13), at Guayama (67–13); on eggplant (51–16); on grass around "El Morro" at San Juan (987–13); at light at Guánica (719B–15); on Mona Island (1318–13).

Schistocerca americana Drury
on sugar cane at Guánica (719–15), at Fajardo (100–18); adults and nymphs abundant on pokeweed, *Phytolacca decandra,* at Yauco (299–21); on Mona Island (1315–13).

Schistocerca columbina Thunberg
(as *Schistocerca cancellatum* Serv.) Gundlach, "vive en los campos y malezas."
(as *Acridium cancellatum* Serv.) Stahl.
(as *S. aegypta* Thunbg.) Rehn 10–76: from Culebra and Vieques Ids., from San Juan and Adjuntas.
Van Z. (P. R. 11). AMNH at San Juan, Mayagüez and Ponce.
Wetmore 16–61, 80, (as sp.) 79: eaten by Ani, Petchary and Kingbird.
Cotton 18–280: on beans. Smyth 19–136: on sugar cane.
on sugar cane at Humacao (55–10), at Guánica (462–14, 719–15); in garden (209–17, 569–16), on beans (1157–16); on grapefruit at Espinosa (90–15); on Mona Island (1316–13); nymph on *Phytolaccus decandra* at Yauco (40–23).

Schistocerca obscurum Fabr.
(as *Acridium*) Stahl. Gundlach.

Schistocerca pallens Thunberg
Van Dine 13–35: eating leaves of sugar cane. Colón 19–58.
Smyth 19–136: on sugar cane.
Wolcott 21–12: rare in cane fields.
on sugar cane at Guayama (68–13), at Mameyes (804–12), on Vieques Island (GNW); on tobacco at Cayey (331–17).

Schistocerca peregrinum Olivier
(as *Acridium*) Stahl. Gundlach.

TETTIGONIIDÆ (LOCUSTIDÆ).

Anaulacomera laticauda Brunner
on weeds in coffee grove at Lares (106–22), on *Inga vera* at Cayey (351–22).

Microcentrum triangulatum Brunner
Wetmore 16–58: eaten by Mangrove Cuckoo.
Smyth 19–137: on sugar cane, not common.
at light (341–12, 342–12, 216–13, 10–15, 422–17, 20–19), at Aguirre (70–13); on grapefruit at Pueblo Viejo (456–16); nymphs feeding on leaves of sweet-potato and castor bean (83–20); on *Phytollaca decandra* L. in mountains north of Yauco (289–21); eggs on cycad (448–19), on *Ficus* sp. (GNW), very abundant on Bougainvillea leaves at Pt. Cangrejos (GNW) laid along main veins or on margin. Nymphs are varigated and bright colored, later becoming all green except at distal end of tibiae and angles of short wings, which are brown and in the last instar are all green as are the adults.

Turpilia rugulosa Brunner
in grapefruit grove at Vega Alta (213–17); at light (85–23).

Neoconocephalus triops Linn., var. **macropterus** Redt. (green) **and fuscostriatus** Redt. (brown)

Wetmore 16–22, 61, 119, (as sp.) 58, 82: eaten by Cuban Green Heron, Ani, Mozambique, Mangrove Cuckoo, and Flycatcher.

(as *Conocephalus nieti* Saussure) Gundlach; from Mayagüez.

(as *Conocephalus*) Van Z. (P. R. 4).

Rehn 10–76: from San Juan and Bayamón.

Wolcott 21–12: eggs, nymphs and adults on sugar cane.

(as *N. mexicanus* Saussure) Smyth 19–136: on sugar cane.

on cane (60–12, 65–12), at Guánica (28–13, 662–14), at Toa Baja (448–21); at light (64–12, 150–15, 430–16, 145–17, 566–17, 705–17), at Guánica (586–13).

Neoconocephalus obscurellus Redtenbacher

(as *Conocephalus*) Van Z. (P. R. 5).

Neoconocephalus guttatus Serville

Rehn 10–76: from Bayamón and El Yunque.

Homorocoryphus sp.

Wetmore 16–61, 91: eaten by Ani and Mockingbird.

Conocephalus cinereus Thunberg

(as *Neoconocephalus*) Smyth 19–137: on sugar cane.

Wolcott 21–12: in cane fields where other grasses are growing.

AMNH at Arecibo, Coamo Springs and San Juan.

in tunnel of digger wasp (753–12), on grass (1211–13), in pasture (208–17), on young cane (33–17), at Vega Baja (449–21); at light (564–17), on beans (208–16, 332–17); on rice at Canovanas (189–16) but more abundant on high grass around fields; on sugar cane at Guánica (312–21).

Conocephalus fasciatus DeGeer

Rehn 10–76: from Vieques Island.

(as *Xiphidion*) Van Z. (P. R. 4).

Polyancistrus serrulatus Palisot de Beauvois

Brunner, von Wattenwyl, Carl, "Monographie der Pseudophyllidea" *in* Der. K. K. Zool. Botan. Gesell, in Wien, p. 233, pl. ix, fig. 101, 1895.

Phlugis virens Thunberg

(as *Alogopteron carribbeum*) Rehn, J. A. G., *in* Ent. News, Vol. 14, p. 141, 1903, TYPE from Porto Rico.

Gryllacris sp.

on coffee leaves, in spider nest made in curled up leaves, in mountains north of Yauco (383–21, 279–21); all specimens nymphs.

GRYLLIDÆ.

Scapteriscus abbreviatus Scudder — det. Chittenden, confirmed Caudell.
one specimen (188–17).

Scapteriscus vicinus Scudder — the "changa".
(as *Gryllotalpa hexadactyla* Perty) Stahl. Gundlach, "Esta especie abunda en Mayagüez y vuela muy frecuentemente a la luz de las casas. Vive en la tierra donde hace daño. Por la noche, principalmente después de un aguacero fuerte, deja oir un sonido muy monótono, pero suave, producido por la fricción de sus alas; si uno se aproxima, cesa el sonido, pues el insecto percibe la pisada. Para cogerlo es menester aproximarse con sumo cuidado, averiguar donde suena y sacar con un golpe de guataca la tierra con el insecto."
Busck 00–90: "Dr. Stahl - - - told me it was a comparatively new insect in Porto Rico, having been introduced within his recollection."
(as *Scapteriscus didactylus* Latr.) Barrett, O. W., "The Changa or Mole Cricket" Bul. 2, P. R. Agr. Expt. Sta. at Mayagüez, 1902. pp. 1–19. fig. 1.; an extended account, description and figure of adult, life history, natural enemies and methods of control.
(as *S. didactylus* Latr.) Rehn 10–76: from Luquillo and El Yunque.
(as *S. d.* Latr.) Van Z (914) attacking "roots of grasses and of practically all young tender plants."
(as *S. d.* Latr.) Crossman, S. S. & Wolcott, G N, "Control of the Changa", Circ. 6, Insular Expt. Sta., Río Piedras, 1915, pp. 1–3: control with Paris Green and flour mixture.
(as *S. didactylus*) Wetmore 16–9: "Bird Enemies of the Mole Cricket". Over half the food of the Cuban Green Heron and over quarter of the food of the P. R. Sparrow Hawk, nearly a sixth of that of the Antillean Killdeer, and a tenth of that of the Spotted Sandpiper is the changa.
Van Zwaluwenburg, R. H., "The Changa or West Indian Mole Cricket". Bul. 23, P. R. Agr. Expt. Station at Mayagüez, pp. 1–27, pl. 3, Feb. 12, 1918, Washington, D. C.: an extended account and a complete bibliography.
Cotton 18–270: a pest of vegetables and control. Illustration of adult.
adults at light (34–11, 118–11, 329–13, 807–19, 71–19), at Arecibo (13–15), at Condado (64–11), at Guánica (11–10, 546–13, 660–14, 906A–14); attacking rice (622–17); attacking tobacco at Caguas (23–10); attacking sugar cane at Fajardo (20–11), at Arecibo (179–11, 183–11), at Ponce (936–13); attacked by ants (1213–13); attacked by ants, *Pheidole fallax* var. *antillensis* Forel (det. Mann) at Saldinera, Dorado (GNW).

Ellipes minuta Scudder
(as *Tridactylus histrio* Saussure) Gundlach.
Wetmore 16–39, 57, 89: eaten by Killdeer, Mangrove Cuckoo and Martin.
Wolcott 21–12: "in great abundance in low wet cane fields with sandy soil, at Martin Peña and Garrochales."
very abundant on sandy shore of Laguna del Tortuguero at Algarroba (774–14); at light (45–21) and swept from meadow (438–16); nymphs and adults in enormous numbers in drying-up, but still moist, ditches in cane field at Barceloneta (20–22), along margin of stream at Boquerón (105–23), averaging possibly five or six per sq. in., burrowing in the soil and apparently feeding on humus or very small roots, or resting with only head and thorax exposed.

Cycloptilum antillarum Redtenbacher
(as *Liphoplus krugii* Saussure) Gundlach, "de los contornos de Mayagüez".

Anurogryllus muticus DeGeer
Gundlach. Rehn 10–77: from Culebra Id. and Coamo Springs.
Wetmore 16–61, 66, 116, 119: eaten by Ani, Owl, Oriole and Mozambique.
at light (179–21); in tobacco field at Cayey (360–22).

Gryllodes sigillatus Walker
(as *G. poeyi* Saussure) Rehn 03–135.

Gryllus assimilis Fabr.
Ledru, 1797. (as *G. cubensis* Saussure) Stahl.
(as *G. aztectus* Saussure) Gundlach, "Es especie común y dañina en jardines y huertas. De día está escondido y de noche sale a comer. Emite un sonido fuerte en proporción al tamaño de su cuerpo, incomodando si ha llegado a un dormitorio."
Wetmore 16–22, 61: eaten by Cuban Green Heron and Ani.
at light (254–12), at Guánica (327–13, 579–13); in cane field (37–12); attacking tobacco roots stems and leaves at Cayey (6–21); attacking beans and cotton, and feeding on fresh cow manure in road at Boquerón (37–23).

Anaxipha pulicaria Burmeister
Rehn 03–135.

Cyrtoxipha imitator Scudder
Rehn 03–135.

Cyrtoxipha gundlachi Saussure
Gundlach, "en las cercanías de Mayagüez." Van Z. (P. R. 14).
Smyth 19–137: "on sugar cane, citrus, banana".
abundant on eggplant (14–16); in leaf-sheath of corn (501–17),; on grapefruit at Vega Alta (49–17).

Hapithus tenuicornis Walker
adults at light at Guánica (579–13).

Orocharis vaginalis Saussure
Gundlach, "en las cercanías de Mayagüez."
Saussure, H., Biol. Centr. Amer., Orthoptera, p. 276–7, 1897.
Van Z. (P. R. 10). Smyth 19–137: on sugar cane and citrus.
Wolcott 21–49: nymphs and adults feeding on leaves of coffee and grapefruit.
(as sp.) Wetmore 16–84, 116: eaten by Wood Pewee and Oriole.
at light (41–21, 89–21, 625–21, 73–22, 367–22), at Manatí (112–16), in all cases probably attracted from citrus trees; on grapefruit at Pt. Salinas, Plantaje (177–15), at Vega Alta (48–17, 225–17), at Vega Baja (498–17), at Santana (213–16); on coffee, eating leaves along midrib (46–21), at Jájome Alto (370–21), and observed at many points in the coffee districts; on weeds (17–16), at Cayey (321–17).

Orocharis terebrans Saussure, H., *in* Biol. Centr. Amer., Orthoptera, pp. 277, 1879, TYPE from Porto Rico.
Wetmore 16–58: eaten by Mangrove Cuckoo.

Laurepa (Apithis) krugii Saussure, H., "Melanges Orthopterologiques", Fasc. 5, Vol. 25, 1878, p. 607, pl. 18, fig. 64, 1 and 2: TYPE from Porto Rico.
(as *Apithis*) Gundlach.
at Bayamón (181–22); on branch of mangrove at Boquerón (180–23).

Diatrypa sibilans Saussure, H., 78–562, TYPE from Porto Rico.

Phalangopsis guerrina Saussure
Stahl.

Amphiacusta caraibea Saussure
Rehn 10–77: from caves near Pueblo Viejo and San Juan, on El Yunque, and on Culebra and Vieques Ids.
Van Zwaluwenburg 18–26: "A Cricket Attacking Seedlings" —"a household pest of foodstuffs. The damage done to plants is similar to that caused by cutworms and is even mistaken for the work of changas. Flour and Paris green were used successfully in control." Description of eggs.
Cotton 18–270: "sick cricket", a pest of vegetables, "nocturnal in habit, hiding during the day under trash or in cracks in the soil and coming out at night to feed." Control by poison bait for grasshoppers. Illustration of adult.
in the laboratory (22–15, 66–15, 151–15, 20–16); in the cottages at Pt. Cangrejos (82–16, GNW); (determinations doubtful) in rotten tree trunk at Lares (105–22); in rotten log in mountains north of Yauco (239–22); on the beach at Arecibo under coconut husks (248–22).

Stenogryllus sp.

Wolcott 23–57: on coffee.

One female in hollow in coffee tree at Aibonito (489–21). Antennae 3 in. long, color generally light purplish-brown, with lavender bloom, eyes reddish-brown, wings and claspers dull yellow, with veination sharply outlined in brown. Many large spines on tibiae and tarsi of hind legs. Total length 1½ in.

on twig of mangrove at Boquerón (179–23).

NEUROPTERA (of Sharp).

LITERATURE.

Kolbe, H. J., "Neuroptera v. d. Sammlung von Herr Krug." Archiv. fur Naturgeschichte, Vol. 1, No. 2, 1888.

MALLOPHAGA.

Menopon pallidum Nitzsch—det. F. C. Bishopp
on fowl (291–23).

EMBIIDÆ.

Oligotoma cubana Hagen
Gundlach. Kolbe.

ISOPTERA

TERMITES (TERMITIDÆ of Sharp).

To Dr. T. E. Snyder, the writer is greatly indebted for the determination of all specimens of termites, the description of new species, the rearrangement of this list and the adding to it of species recorded in literature not available to the writer.

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Wolcott, G. N., "Los Comejenes de Puerto Rico" Circ. 44, Insular Experiment Station, Río Piedras, August 1921, pp. 1–14, figs. 12.

KALOTERMITIDÆ.

Neotermes castaneus Burmeister (as *Calotermes*), TYPE probably from Porto Rico.
(as *Calotermes*) Stahl. Gundlach, "Vive escondida dentro de las maderas muertas."

Cryptotermes brevis Walker
(as *Calotermes*) Gundlach, "Vive como la precedente." Kolbe.
(as *Leucotermes* sp.) Van Zwaluwenburg 16–44: "in woodwork and furniture, hollowing out irregular galleries with the grain of the wood, and often leaving only a very thin partition to conceal the galleries from the outside. Often the first indication of infestation by this species is the presence of fine granular droppings beneath the wood. Fumigation with hydrocyanic–acid gas" as control.
Wolcott 21–10: "polilla que destruye los muebles y las casas." A rather extended account, with illustrations of work, nympn, soldier and dealated adult: life-history and control.

in pine wood (184–22), common in houses and furniture; in telephone pole at Cayey (GNW).

Glyptotermes pubescens sp. nov. Snyder MS. Proc. U. S. National Museum, Washington, D. C. TYPE from Porto Rico.
one colony in interior of live coffee tree, covered with orchids, and with top dead, at Aibonito (488–21 TYPE).

Glyptotermes corniceps sp. nov. Snyder, T. E., "A New Glyptotermes from Porto Rico" *in* Proc. Ent. Soc. Washington, Vol. 25, No. 4, April, 1923, pp. 91–93, pl. 1.
one small colony in small tree at Boquerón (81–23 TYPE).

RHINOTERMITIDÆ.

Leucotermes tenuis Hagen
Banks 19–481: at Aibonito.

Constrictotermes discolor Banks 19–489, TYPE from Porto Rico.
Wolcott 21–3: mention.
in rotten stump of *Inga vera* in coffee grove at Ciales (216–22), in dead tree of *Inga vera* at Lares (253–22), no external nest but interior of rotten stump hollowed out and lined with very dark brown termite building material, runways in tree under bark.

Tenuirostitermes wolcotti sp. nov. Snyder MS
on dead wood of "hucar" tree, *Bucida buceras*, at Boquerón (323–23), making tunnels an inch or more broad of soil, with apparently little organic content, over the dead wood, but constructing no nest.

Eutermes debilis Heer
Gundlach (after Kolbe). Banks 19–482.
Wolcott 21–3: mention.

Nasutitermes morio Latreille
(as *Termes*) Stahl, "comején."
(as *Eutermes*) Gundlach, "Muy común y causa mucho daño cuando se ha fijado en habitaciones del campo. Su nido es visible y consiste en una masa pardo-obscuro, dura, alcanzando un gran tamaño." Kolbe.
(as *Eutermes*) Van Z. (1710). Van Zwaluwenburg 16–43: notes, and control "by placing liberal quantities of any powdered arsenical poison in the runways and nest."
Banks 19–486:
Wolcott 21–3: a rather extended account, with seven illustrations.
nest in coconut palm (108–15), on jobo, *Spondias lutea*, tree (178–21); four adults, apparently starting a colony in rotten twig of *Bixa orellana* tree at Lares (134–21); alate adults at light, June 15 (111–15).

Nasutitermes creolina Banks
Banks 19–484:
Wolcott 21–3: mention.
nest in algarrobo tree, *Hymenaea courbaril,* (170–21), light brown in color, the outside layers being of uniform brittle character, the interior layers very hard and tough and containing many hard balls about an inch in diameter with two or more narrow tunnels leading to the interior. The exterior tunnel to the ground was nearly an inch broad. Only workers, nasuti and immature stages found (July 8). The workers bit viciously.

Nasutitermes sanchezi Holmgren
Banks 19–487:

Nasutitermes costaricensis Holmgren
Holmgren, "Monograph Amerikanen Eutermes-Arten" Mitth. Naturh. Mus. Hamburg, Vol. 27, (1909) 1910, p. 237:
Banks, Nathan & Snyder, T. E., "Revision of Nearctic Termites" Bull. 108, U. S. National Museum, 1920, p. 82:

CORRODENTIA.

PSOCIDÆ.

Caecilius sp. — det. Dr. Nathan Banks
under silken shelters on the underside of mealybug infested leaves of *Erythrina glauca* (66–23).

Pseudocaecillus wolcotti sp. nov. Banks M. S.
under silken shelters on the underside of leaves of *Erythrina glauca* (66–23), of coconut palm (141–23).

Peripsocus minutus sp. nov. Banks M. S.
on bean pods of "aroma", *Acacia farnesiana,* from Boquerón (143–23).

ODONATA.

AGRIONIDÆ.

Protoneura capillaris Rambur
Kolbe 88–170. Gundlach.

Ceratura capreola Hagen
Kolbe 88–165: mention. Gundlach.

Ischnura ramburii Selys
Kolbe 88–170. Gundlach.

Enallagma civile Hagen
Kolbe 88–170. Gundlach.

Enallagma caecum Hagen
Kolbe 88–165. Gundlach.

Enallagma krugii Kolbe 88–171, TYPE from Porto Rico. Gundlach.

Erythragrion dominicanum Selys
Kolbe 88–172. Gundlach.

Erythragrion vulneratum Hagen
Kolbe 88–165. Gundlach.

Leptobasis vacillans Hagen
Kolbe 88–172. Gundlach.

Lestes spumaria Hagen
Kolbe 88–172. Gundlach.

AESCHINIDÆ.

Gymnacantha trifida Rambur
Stahl. Gundlach.

Gymnacantha nervosa Rambur
Kolbe 88–168. Gundlach.

LIBELLULIDÆ.

Pantala flavescens Fabr.
Gundlach.

Tramea abdominalis Rambur
Kolbe 88–167. Gundlach.

Libellula umbrata Linnaeus
Stahl. Kolbe 88–167. Gundlach.

Orthemis discolor Burmeister
Stahl. Kolbe 88–168. Gundlach.

Lepthemis vesiculosa Fabr.
Kolbe 88–168. Gundlach.

Dythemis rufinervis Burmeister
Stahl. Kolbe 88–168. Gundlach.

Dythemis discreta Hagen
Kolbe 88–168. Gundlach.

Macrothemis celeno Selys
(as *Dythemis pleurostictia* Hagen) Stahl.
Kolbe 88–168. Gundlach.

Diplax ambusta Hagen
Kolbe 88–168. Gundlach.

Diplax portoricensis Kolbe 88–168, TYPE from Porto Rico.
Gundlach; comparison with *D. minuscula.*

Perithemis domitia Drury
(as *Libellula metella* Selys) Stahl.

MYRMELEONIDÆ.

Acanthaclisis fallax Ramb.
Gundlach.

Myrmeleon insertus Hagen
Kolbe 88–174. Stahl. Gundlach, "común".
(? this sp.) larvae abundant in sandy soil at Guánica (160-13).

Ascalaphus hyalinus Latereille
(as *Ulula*) Kolbe 88–174.
Gundlach.

CHRYSOPIDÆ.

Chrysopa collaris Schneider
Gundlach. Kolbe.
Jones 14–462 (list of insect pests of sugar cane): predaceous on *Sipha flava* Forbes. —det. Banks.
(672–12, 239–16), adults on cane infested with the aphid, *Sipha flava* Forbes (652–12, 785–12), reared from egg, using this aphid for food (709–12), from leaves of *Erythrina* infested with mealybugs, *Pseudococcus nipae* Mask. (155–13); adults abundant on *Amaranthus* at Cayey (128–16); all stages abundant on grapefruit trees at Vega Baja (490–16) "larvae feed on eggs of *Diaprepes spengleri* Linn., also on plant lice and nymphs of *Ormenis* spp." R. T. Cotton; on trunks or foliage of grapefruit at Vega Alta (114–17, 147–17, 214–17); on coffee trees at Corozal (282–21) and occassionally noted in coffee groves in other districts; larvae feeding on *Ceroplastes* sp. scales on *Psidium guajava* (275–13).

Chrysopa externa Hagen
Kolbe 88–173. Gundlach.

Chrysopa krugii Kolbe 88–173, TYPE from Porto Rico.
Gundlach.

Chrysopa thoracica Walker
Gundlach. Kolbe.

Protochrysopa insularis Walker
Gundlach. Kolbe.

PHRYGANEIDÆ. (TRICHOPTERA)

Setodes candida Hagen
Gundlach. Kolbe.

Chimarrha albomaculata Kolbe 88–175, TYPE from Porto Rico.
Gundlach.
adults common at light at Mameyes (197–13 det. Banks).

HYMENOPTERA.

LITERATURE.

(**Cresson, E. T.,** "On the Hymenoptera of Cuba." Proc. Ent. Soc. Philadelphia, January, 1865. pp. 1–200. Contains descriptions of many species found in Porto Rico.)

Dewitz, H., "Hymenopteren von Portorico." Berliner Entomologische Zeitschrift, Vol. 25, pt. 2, pp. 197–208, 1881.

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Wheeler, Wm. M., "The Ants of Porto Rico and the Virgin Islands." Bull. Amer. Mus. Nat. Hist., Vol. 24, Art. 6, pp. 117–158, fig. 4, pl. 2, 1908.

Wheeler, Wm. M., "Ants." Columbia University Press, New York, March, 1910. pp. 1–663, fig. 285.

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Crawford, C. F. W. Muesebeck and A. A. Girault, and a few by Mrs. C. J. Weld. Dr. Wm. M. Wheeler determined most of the ants, although Dr. Wm. Mann has made some of the more recent determinations. Mr. J. D. More prepared the first draft of the section on Formicidae.

APIDÆ.

Apis mellifera Linn. (as **Aphis mellifica** Linn.)
Dewitz. Stahl. Gundlach, "Esta especie fué introducida de Europa y existe ahora, no solamente en los colmenares, sino también cimarrona en árboles huecos de los montes y en las grietas de las peñas."
Busck 00–90: "Very large colonies of a dark variety of *Apis mellifica* were abundant in hollow trees and especially in caves, sometimes also in outhouses. These are annually smoked out and furnish large quantities of honey."
Tower, W. V., "Bee Keeping in Porto Rico." Circ. 13, P. R. Agr. Expt. Station, Mayagüez, 1913, pp. 1–31, fig. 1.
Phillips, E. F., "Porto Rican Bee Keeping." Bull. 15, P. R. Agr. Expt. Station, May 29, 1914, Washington, D. C., pp. 1–24, pl. 2.
Van Zwaluwenburg, R. H. & Vidal, Rafael, "Rearing Queen Bees in Porto Rico." Circ 16, P. R. Agr. Expt. Station, Feb. 26, 1918, Washington, D. C., pp. 1–12, fig. 5.
Wetmore 16–77: worker eaten by Kingbird.

ANTHOPHORIDÆ

Centris haemorhoidalis Fabr.
Dewitz. Gundlach. Van Z. (P. R. 53).
(614–12 det Rohwer.)

Centris lanipes Fabr.
Dewitz. (as *C. fulviventris* Cresson and *C. dentipes* Smyth, not in synonymy) Stahl.
Gundlach, "en Mayagüez."
(724–13 det Rohwer.)

(**Centris ornatifrons** Cresson
Stahl.)

Centris versicolor Fabr.
Dewitz. Stahl. Gundlach, "común." Ashmead.
Wetmore 16–77: eaten by Kingbird.
(as *C. decolorata* Sip.—a misidentification) Van Z. (P. R. 44). on the beach at Arecibo (272–22).

Exomalopsis pulchella Cresson
Dewitz. Stahl. Gundlach, "común." Ashmead.

alopsis similis Cresson
Dewitz. Stahl. Gundlach, "común." Ashmead.

Exomalopsis globosa Fabr.—det. Crawford
tunneling in hard clay at Guánica (GBM)

Anthophora krugii Cresson, E. T., Proc. Acad. Nat. Sci., Philadelphia, 1878, p. 188, TYPE from Porto Rico.
(as *Magilla tricolor* Fabr.) Stahl.
(as *A. tricolor* Fabr.) Dewitz. Gundlach, "Mr. Cresson --- la considero distinta de la *A. tricolor.*"
Van Z. (P. R. 45). Wetmore 16–77: eaten by Kingbird.
adults on flowers (7–117), at Aguirre (371–13); abundant on tomato flowers (132–17); about 100 resting and flying about in weeds, *Parthenium hysterophorus*, in sunshine at midday (448–12); emerging from burrow in bank at side of road, south of Ciales (464–21).

Melissodes mimica Creson
Stahl. Gundlach.

Melissodes trifasciata Cresson, E. T., Proc. Acad. Nat. Sci., Philadelphia, 1878, p. 208, TYPE from Porto Rico.
Stahl. Gundlach.
(561–12)

XYLOCOPIDÆ

Xylocopa brasilanorum Linn.—det. Rohwer
(as *Xylocopa aenipennis* Linn.) Van Z. (P. R. 48).
(as *Xylocopa morio* Fabr.) Dewitz. Stahl. Gundlach, "Es notable por la diferencia de colorido entre el macho y la hembra (males are yellow, females black). Las larvas viven dentro de la madera en divisiones separadas en un tubo común, una encima de otra."
(73–19), a male on *Lantana* (254–17); adults at Guánica (534½–13), at Aibonito (SSC), tunneling in fence post at Loíza (260–16).

MELECTIDÆ.

Crocisa pantalon Dewitz 81–198, TYPE from Porto Rico.
Gundlach, "rara."

Nomada krugii Cresson, E. T., Trans. Amer. Ent. Soc., Vol. 7, p. 75, 1878, TYPE from Porto Rico.
(as *N. cubensis* Cresson) Dewitz. Gundlach. Ashmead.
Ashmead.

Melissa rufipes Perty
Stahl.

MEGACHILIDÆ.

Hypochrotaenia (Pasites) pilipes Cresson
Dewitz. Gundlach. Ashmead.

Coelioxys abdominalis Guerin
Dewitz. Stahl. Gundlach, "en Mayagüez." Van Z. (P. R. 79).

Coelioxys producta Cresson
Stahl.

Coelioxys spinosa Dewitz 81–197, TYPE from Porto Rico.
Gundlach.

Megachile insularis Cresson
Ashmead.

Megachile martindalei Fox—det. Rohwer
on bean flowers (688–17).

Megachile poeyi Guerin
Dewitz. Stahl. Gundlach. Ashmead.
(as sp.) Wetmore 16–61: eaten by Ani.

Megachile singularis Cresson
Dewitz. Gundlach.

Megachile vitraci Pérez—det. Rohwer
the rose-leaf cutting bee, nesting in bamboo (130–22); on Mona Island (1311–13).

PANURGIDÆ.

Panurgus parvus Cresson
Dewitz. Gundlach. Ashmead.

ANDRENIDÆ.

Agapostemon krugii Cresson MS name (Gundlach)
Differs from *A. poeyi* in having base and nerves of wings, and oceli and legs *black.*
at Jájome Alto (69–15).

Agapostemon poeyi Lucas
Dewitz. Gundlach.
at Vega Alta (156–15).

Agapostemon radiatus portoricensis Cockerell, T. A. P., Proc. U. S. Nat. Mus., Vol. 55, No. 2264, 1919, p. 209, TYPE of variety from Mayagüez, Porto Rico.
(as *A. festivus* Cresson) Dewitz.
(as *A. tricolor* Lepel.) Gundlach,— a difference from *A. festivus* of Cuba noted by Gundlach and identified as *A. tricolor* Lepel. by Cresson. Ashmead. Stahl.

Differs from *A. festivus* in having abdomen *brown* above, with basal margin of first four segments of abdomen yellow. Adults swept from grass at Pt. Cangrejos (GNW); twenty or thirty in a cluster on grapefruit leaves at Manatí (216–16 det. Rohwer).

Augochlora parva Cresson
Dewitz. Stahl. Gundlach. Ashmead.
(as sp.) Wetmore 16–77: eaten by Kingbird.

Augochlora busckii Cockerell, T. D. A., Proc. U. S. Nat. Mus., Vol. 37, No. 1717, p. 493, Feb. 2, 1910, TYPE from Porto Rico.

Halictus poeyi Lepeletier
Ashmead. (as sp.) Wetmore 16–84: eaten by Wood Pewee.

VESPIDÆ.

Polistes crinitus Felton—det. Rohwer
(as *Polistes americanus* Fabr.) Dewitz Stahl Gundlach. Ashmead.
Van Z. (P. R. 57).
Jones & Wolcott 22–41: predaceous on pupa of *Prenes nero* Fabr.
(as sp.) Wetmore 16–77, 80, 82, 84: eaten by Kingbird, Petchary, Fly-catcher and Wood Pewee.
at Ponce (109–13), at Añasco (41–10), at Cayey (325–17), at Aibonito (SSC), at Guánica (455–13). Predaceous on *Prenes nero* Fabr. chrysalis (32–21).

Polistes canadensis Linnaeus
Wetmore 16–77: eaten by Kingbird.

Megacanthopus cubensis Saussure
(as *Polybia*) Stahl. Ashmead.
in coffee groves in the mountains, at Ciales (77–21 det. Rohwer, 460–21, 218–22); in grapefruit grove at Vega Alta (516–16, 115–17); on El Duque at Naguabo (729–14).

Megacanthopus indeterminabilis Saussure
(as *Polybia mexicanus* Sauss.) Ashmead.
Van Z. (P. R. 66).

Polybia phthisica Fabr.
Dewitz. Gundlach. Ashmead.

EUMENIDÆ.

Zethus rufinodus Latreille
Dewitz. Stahl. Gundlach, "rara en Puerto Rico."
Van Z. (P. R. 46).
on flowers at Lares (99–22 det. Rohwer).

Eumenes ornatus Saussure
Dewitz. Stahl. Gundlach. Van Z. (P. R. 205).
var. *abdominalis* Drury—det. Rohwer, at Guánica (6–13, 981–16), at Pt. Cangrejos (167–15).

Monobiella atrata Fabr.
(as *Odynerus aethiops* Cresson MS) Stahl.
(as *Rhynchium atratum* Fabr.) Dewitz. Gundlach.

Odynerus bucuensis Saussure (MS)
Stahl. Gundlach.

Odynerus dejectus Cresson
Dewitz. Stahl. Gundlach, (as *O. cressoni* Sauss.). Ashmead. (as sp.) Wetmore 16–80: eaten by Petchary.

Odynerus (Pachodynerus) tibialis Saussure
AMNH

PSAMMOCHARIDÆ (POMPILIDÆ).

Pepsis caerulia Linn.
(as *P. speciosa* Fabr., synonymy by Gundlach) Dewitz. Ashmead. Gundlach.

Pepsis marginata Palisot de Beauvois
Stahl.
adults on flowers (306–12, 584–16, 517–18).

Pepsis heros Dahlbom
Dewitz. Gundlach. Ashmead.
(as sp.) Wetmore 16–77: eaten by Kingbird.
adults near the beach at Santa Isabel (369–13), at Pt. Cangrejos, (396–22).

Pepsis rubra Drury—det. Rohwer
(626–12), at Pt. Cangrejos, feeding on flowers of *Mitracarpus portoricensis* (395–22), at Aguirre (69–16), at Santa Isabel (369–13).

Pepsis ruficornis Fabr.
Dewitz. Stahl. Gundlach. Ashmead.
(two unlabeled specimens)

Psammochares cubensis Cresson
(as *Pompilus anceps* Cresson) Stahl. Gundlach.
(as *Pompilus*) Ashmead.

Psammochares (Pompilus) coruscus Smith
Gundlach, "algo rara." Dewitz.

Psammochares (Pompilus) cressoni Dewitz 81–203, TYPE from Porto Rico.
Gundlach, "rara."

Psammochares ferrugineus Dahlbom
(as *Pompilus*) Dewitz. Gundlach, "rara." Ashmead.

Psammochares fulgidus Cresson
(as *Pompilus*) Dewitz. Gundlach, "cogida en Quebradillas."

Psammochares navus Cresson
(as *Pompilus*) Gundlach.

Pompiloides propinquus Fox—det. Rohwer
(648–12), at Guayama (668–17).

us flavopictus Smith
(as *Pompilus*) Gundlach, "rara."

Batazonus hookeri Rohwer 15–237, TYPE from Mayagüez, Porto Rico.
at Ponce (109–13)

mundus Cresson
(as *Pompilus concinnus* Cresson) Dewitz.
(as *Pompilus*) Gundlach. Ashmead.

Cryptocheilus flammipennis Smith
(as *Pompilus ignipennis* Cresson) Dewitz. Ashmead.
(as *Pompilus*) Gundlach, with *P. ignipennis* in synonymy, "rara."
at Cayey (26–21).

Pseudagenia bella Cresson
(as *Pompilus*) Dewitz. Gundlach, "en Mayagüez." Ashmead. Van Z. (det. Rohwer).

CRABRONIDÆ.

Crabro croesus Lepeletier
Dewitz. Gundlach, "Los ejemplares de Puerto Rico diferentes en algo del tipo cubano — en el color de la pubescencia." Van Z. (P. R. 64).

Crabro mayeri Dewitz 81–201, TYPE from Porto Rico.
Gundlach, "en los contornos de Mayagüez."

Psen (Mimesa) modesta Rohwer 15–244, TYPE from Mayagüez, Porto Rico.

Cerceris krugii Dewitz 81–201, TYPE from Porto Rico.
Gundlach, "en varias localidades."
(as sp.) Wetmore 16–98: eaten by Jamaican Vireo.

Cerceris margaretella Rohwer 15–248, TYPE from Mayagüez, Porto Rico.

Trachypus gerstaeckeri Dewitz 81–202, TYPE from Porto Rico.
Gundlach, "en Mayagüez."

NYSSONIDÆ.

Nysson (Bathystegus) basirufus Rohwer 15–247, TYPE from Mayagüez, Porto Rico.

Hoplisus (Hoplisoides) scitulus Cresson—det. Rohwer
(891–13).

BEMBECIDÆ.

Bembex ciliata Fabr.
Dewitz. Stahl. Gundlach, "vive en las playas." Ashmead. at Santa Isabel (419–13 det. Rohwer).

Bembex regularis Cresson
Stahl.

Stictia signata Linn.
(as *Bembex*) Ledru 1797. Dewitz. Stahl.
(as *Monedula*) Gundlach, "común en terrenos arenosos, cavando allí hoyos con mucha prontitud. Apenas se le ve posarse, pues vuela prontamente como jugueteando un individuo con otro."
at Algarrobo (759–14), at Trujillo Alto (888–13), at Dorado around icaco blossoms (715–13), on sandy ground at Vega Alta (169–15); chasing *Chrysops costatus* Fabr. on horses at Pt. Salinas (GNW), chasing flies attracted to molasses (182–21 det. Rohwer).

Microbembex monodonta Say—det. Rohwer
(one unlabeled specimen.)

LARIDÆ.

Notogonidea fuliginosa Dahlberg
(as *Larrada*) Stahl. Gundlach.

Notogonidea ignipennis Smith
(as *Larrada*) Dewitz. Gundlach, "en Quebradillas."
Van Z. (P. R. 71).
at Ponce (108–13 det. Rohwer), on cane at Guánica (GNW).

Notogonidea luteipennis Cresson
(as *Larrada*) Dewitz. Stahl. Gundlach.

Notogonidea trifasciata Smith
(as *Larrada*) Dewitz. Stahl. Gundlach. Ashmead.

Notogonidea vinulenta Cresson
(as *Larrada*) Gundlach.
Van Z. (det. Rohwer).

Tachytes argentipes Smith—det. Rohwer
(650–12, 684–12, 125–17, 138–17), on corn leaves at Aguadilla (25–22).

Tachytes insularis Cresson
Dewitz. Gundlach, "rara."

Prionoyx thomae Fabr.
Dewitz. Stahl. Gundlach. (as *Chlorion*) Van Z. (P. R. 1011).
(as sp.) Wetmore 16–77: eaten by Kingbird.

(as *Sphex*) AMNH.
(768–12) on dry hill at Ponce (107–13), at Isabela, carrying off small grasshopper, larger than herself (210–21).

Ammobia dubitata Cresson—det. Rohwer
(as *Chlorion*) Van Z. (P. R. 93).
(803–14); with *Conocephalus fasciatum* DeG. in her burrow (675–12).

Ammobia ichneumonea Linn. var. **auriflua** Perty
(as *Sphex croesus* Fabr. and as *S. auriflua* Perty) Stahl.
(as *Sphex*) Dewitz. Gundlach, giving also determination by Saussure as *Sphex croesus.*
(as *Sphex* and as *Sceliphron*) Ashmead.
on flowers at Pt. Cangrejos (606–17).

SCOLIIDÆ.

Elis haemorrhoidalis Fabr. = **Elis (Myzine) sexcincta** Fabr.
(as *Myzine sexcincta* Fabr., with *Myzine nitida* Cr. and *Tiphia haemorrhoidalis* Fabr. in synonymy with different specimens) Stahl.
(as *Myzine sexcincta* Fabr.) Dewitz. Gundlach. Aldrich.
(as *Elis sexcincta* Fabr.) Van Dine 13–29; Van Dine 13–254 and Smyth 17–55: mention.
Van Z., as parasitic on *Lachnosterna* spp.
(as *Elis sexcincta* Fabr.) Wetmore 16–82: eaten by Flycatcher.
Wolcott 22d–14: parasite of grubs of *Phytalus insularis* Smyth.
males common on sandy land, in clusters of hundreds, resting on weeds, or flying about close to the soil, at Trujillo Alto (885–13), at Algarrobo (766–14), at Guánica (663–14), at Pt. Cangrejos (GNW), on Vieques Id. (GNW). Females with stouter bodies, in cane field at Barceloneta (17–22), in grapefruit grove (281–16), feeding on excrement of *Aphis gossypii* Glover on cotton at Isabela (218–21).
Both sexes reared from cocoons collected in plowed field at Plantaje, Pt. Salinas, in outer threads of which were entangled the mandibles of *Phytalus apicalis* Blanchard (= *P. insularis* Smyth) third instar grubs (64–22). From some cocoons a hyperparasite, *Anthrax gorgon* Fabr. (64A–22) emerged.

Elis ephippum Fabr.
(as *Myzine*) Gundlach, "rara." Ashmead.
(as *Tiphia*) Dewitz.
(as *Myzine apicalis* Cresson — described from a male) Stahl. Gundlach, "común ... acaso sea la misma que *M. ephippum* Fabr."
(as *Elis xanthonotus* Rohwer 15–234, TYPE (113–12) from Porto Rico.)

Rohwer, S. A., Proc. U. S. Nat. Mus., Vol. 57, No. 2312, 1920, p. 228: synonymy of *E. xanthonotus,* described from a female, with *Elis ephippum* Fabr.
(as *Elis xanthonotus* Roh.) Smyth 17–55: mention.
(as sp.) Wetmore 16–77: eaten by Kingbird.
Wolcott 22d–14: mention.
females (113–12), on flowers (1212–13), in greenhouse (365–19), one male (unlabeled) agrees with Cresson's description of *Myzine apicalis* except that the femora are piceous on basal half, extending to apex beneath, otherwise yellow, and all tibiae are yellow. "The female wasps occur on the flowers of *Hyptis atrorubens,* the males on those of *Mitracarpus portoricensis.* The male wasps differ greatly from the female, being slender with yellow stripes, and the characteristic upturned genital organ." E. G. Smyth.

Myzine nitida Smith
Stahl.

Tiphia argentipes Cresson
Dewitz. Stahl. Gundlach, abundant. Ashmead.
(as sp.) Wetmore 16–77: eaten by Kingbird.

Tiphia sp. (possibly the above)
Wolcott 22d–12; Wolcott 23–55: notes.
three males collected by Mr. E. H. Barrow, feeding on secretions of a scale, *Pulvinaria psidii* Mask., on *Rauwolfia nitida* at Guánica, (243–21) — "closely allied to *floridana* Robertson and *illinoiensis* Robertson" — det. Rohwer, another male, same data (318–21), another male on cotton at Yauco (39–22).

Campsomeris atrata Fabr.
(as *Scolia*) Dewitz. Stahl. Gundlach, "muy común; su vuelo es lento y con ruido visita las flores."
Ashmead. Wolcott 22d–14: mention.
from flowers in cane field at Aguirre (370–13); a female at Lares (13–23).

Campsomeris dorsata Fabr.
(as *Tiphia*) Dewitz. (as *Scolia*) Stahl. Gundlach, "rara."
Van Z. (P. R. 43).
Van Dine 13–254; Colón 19–51; Smyth 17–55: mention.
Wetmore 16–77, 80, 91: eaten by Kingbird, Petchary and Mockingbird.
Smyth 19–141; Wolcott 21–44; Wolcott 22d–14: parasitic on grubs of *Ligyrus tumulosus* Burm.
"While I was getting these grubs (of *Ligyrus tumulosus* Burm.) I found 28 cocoons of a wasp, very probably the black one with two reddish bands across the abdomen, because while digging, two flew out. This wasp is commonly seen in the callejones and cane fields. I also found one grub with a large size larva of a wasp attached to its body, one grub with a

medium sized larva attached to it, and one with the egg of the wasp freshly laid on its body" letter of H. Bourne (June 20, 1913) from Hacienda Santa Rita, Guánica, P. R. Reared to adult (495–13).

common on south (dry) side of the island on sandy land, feeding on the nectar of flowers or resting on cane leaves, at Guánica or Yauco, (46–11, 48–11, 232–11, 380–12, 99–13, 100–13, 106–13, 504–13, 136–21, 241–22), at Ponce (68–15), at Aguirre (372–13), at Arroyo (101–16).

on the north side (580–12), at Maunabo (666–17), at Trujillo Alto (889–13), at Arecibo (18–15).

Campsomeris pyrura Rohwer 15–235, TYPE from Mayagüez, Porto Rico.
Smyth 17–55, Wolcott 22d–14: mention.
on flowers of *Stachytarpheta jamaicensis* near Comerío (771–13).

Scolia plumipes Drury
Dewitz. Gundlach, "rara."

Campsomeris trifasciata Fabr.
(as *Tiphia*) Dewitz. (as *Scolia*) Stahl. Gundlach, "común." Van Z. (P. R. 42). Smyth 17–55; Wolcott 22d–14: mention.
(as sp.) Wetmore 16–77, 80: eaten by Kingbird and Petchary.
(749–12, 740–12, 926–13), at San Juan (990–13), at Maunabo (667–17).

Campsomeris maculata Drury = **C. druryii** Ckll. — synonymy by Rohwer
Ashmead.

Campsomeris tricincta Fabr.
Ashmead. (as *Scolia*) Stahl. Gundlach.

FORMICIDÆ.

(The first draft of this section was prepared by Mr. J. D. More.)

PONERINAE.

Platythyrea punctata F. Smith
Wheeler: between Arecibo and Utuado, "in a shady cafetal."

Euponera (Pseudoponera) stigma Fabr.
Wheeler: in Culebra Island and at Utuado, "nesting under stones or logs."

Ponera opaciceps Mayr
Wheeler: on Culebra Id., at Utuado, Monte Morales, Monte Mandios and at Coamo Springs, "under bark of decaying logs in damp places."
Wetmore 16–87: eaten by Swallow.

Ponera ergatandria Forel
Wheeler: at Utuado.

Anochetus mayri Emery
Wheeler: at Utuado, Vega Baja, Monte Morales and Monte Mandios, at Coamo Springs, San Juan, Adjuntas, Arecibo, "common under dead leaves and stones in the shade of cafetals and platanals."

Anochetus (Stenomyrmex) emarginatus testaceus Forel
Wheeler: on Culebra Id., "along dry arroyos on the higher part of the island."

Odontomachus haematodes Linn.
Wheeler: at many localities, "common, nesting under stones or logs or in untidy mound nests about the roots of trees, but only in shady places and rather rich soil."
Wetmore 16–80: eaten by Petchary.
at Ciales in rotten stump (59–21).

Odontomachus heamatodes Linn., subsp. **insularis** Guerin, var. **ruginodis** Wheeler—popularly known as "berraco".
Wheeler: at Utuado, Adjuntas, Coamo Springs, "less common — in open sunny places in sandy soil of river bottoms."
Wetmore 16–91: eaten by Mockingbird.
(705–16, 1117–16), at base of tree (267–12), in rotten coconut husks (183–21), with *Pseudococcus sacchari* Ckll. under leaf-sheaths of sugar cane (162–11); at roots of sugar cane at Guánica (226–11), on Vieques Id. (GNW); on sugar cane at Guayanilla (GNW).

MYRMICINAE.

Pseudomyrma flavidula F. Smith
Wheeler: a single worker at Tallaboa.

Pseudomyrma flavidula Smith, var. **delicatula** Forel—det. Wheeler
on trunk of rotten tree and on sugar cane (323–12): on coffee tree at San Germán (399–21); on cotton at Pt. Cangrejos (605–22); in termite nest at Ciales (612–22).

Monomorium destructor Jerdon
Wheeler: "a single colony nesting at the base of *Acacia farnesiana* tree at Tallaboa." Van Z. (P. R. 1013).

Monomorium minutum Mayr
Van Z. (P. R. 622).

Monomorium pharaonis Linn.
Wheeler: "common in houses and hotels — also nesting out of doors in the ground on Culebra Id."
Van Z. (P. R. 1014).
in houses (153–11, 681–12).

Monomorium carbonarium F. Smith, subsp. **ebeninum** Forel

Wheeler: on Culebra Id., and at many places in Porto Rico "under stones, in Tillandsias and under bark."

Van Z. (P. R. 322).

Van Dine 13–32, Jones 16–15, Colón 19–30: attending *Sipha flava* Forbes on sugar cane.

nesting under leaf-sheaths of sugar cane (161–11), in tunnel of *Diatraea saccharalis* Fabr. in sugar cane (204–11), attending *Sipha flava* Forbes on young sugar cane (328–12, 333–12), on seed cane (721–12) — all det. Wheeler — nesting in cabbage head (408–19) tunneling among the inner leaves; under cow dung (268–12); attacking larva of *Desmia ufeus* Cramer (601–21); attending *Sipha flava* Forbes on sugar cane at Guánica (227–15); on coffee at San Sebastián (604–21); "injurious to the fruits of roselle, *Hibiscus sabdariffa*, by nesting in them." E. G. Smyth.

Monomorium floricola Jerdon

Wheeler: "common in Tillandsias, under bark-scales of trees and in hollow twigs."

Van Z. (P. R. 1015).

Wetmore 16–63: eaten by Woodpecker.

(142–11), carrying away dead flies (455–12), on cotton (355–21); in tunnel of *Diatraea saccharalis* Fabr. in sugar cane at Humacao (51–13); nesting in hollow twigs on coffee at Lares (151–20), at Peñuelas (397–21), at Sabana Grande (398–21), at San Germán (400–21), in empty cocoon of *Megalopyge krugii* Dewitz on coffee at Caguas (112–21).

Cardiocondyla emeryi Forel

Wheeler: on Vieques and Culebra Ids., and at many places in Porto Rico, "The colonies — are small and in sandy places, especially in river or creek bottoms and on sea beaches."

Wetmore 16–63: eaten by Woodpecker.

Cardiocondyla venustula Wheeler 08–128, TYPE from Coamo Springs, Porto Rico.

Wheeler: in small colonies in sandy and gravelly beds of streams or on sea-beaches. Also from Culebra Id. Illustration of worker.

Wheeler 10–126: same illustration.

Wetmore 16–87: eaten by Swallow.

Solenopsis geminata Fabr., the "**hormiga brava.**"

Barrett, O. W., "Control of the Brown Ant (*Solenopsis geminata* Fabr.) in Orange Orchards." Circ. 4, P. R. Agr. Expt. Station, May 9, 1904. pp. 1–3.

Barrett 05–388: injurious to citrus trees.

Tower, W. V., "Control of the Brown Ant (*Solenopsis geminata* Fabr.) and the Mealy Bug (*Pseudococcus citri* Risso) in

Pine-Apple Plantations." Circ. 7, P. R. Agr. Expt. Station, (no date) pp. 1–3.
Wheeler: "commonest of all the ants — except in — Culebrita. — This ant not only stores up seeds in its nests and is highly carnivorous, but it also attends aphids and coccids." With *Aphis nerii* Boyer on milkweed at Culebra.
Wheeler 10–126: on Culebra Id.
Tower 11a–11: injury to citrus groves and methods of control.
Van Dine 11–29; Van Dine 12–20; Van Dine 13–30: attending *Pseudococcus sacchari* Ckll. on sugar cane.
Van Dine 13–32; Jones 15b–15: attending *Sipha flava* Forbes on sugar cane.
Jones 15b–17: attending *Aphis setariae* Thos. on sugar cane.
Van Z. (P. R. 311).
Jones 15–9: injuring okra plants.
Wetmore 16–40, 61, 66, 74, 116, 119, 128: eaten by Killdeer, Ani, Tody, Mango, Oriole, Mozambique, and Grasshopper Sparrow.
Cotton 18–296: injuring eggplant.
Colón 19–32: summary of injuries.
Wolcott 22–10: protecting aphids.
Smyth 19–138: "injures citrus, cowpeas, eggplants and bananas." attending *Pseudococcus sacchari* Ckll. on sugar cane (147–11, 595–12), at Guánica (288–11); attending *Pseudococcus nipae* Mask. on *Psidium guajava* (270–12); attending *Saissetia hemisphaerica* Targ. on coffee at Lares (162–20); attending *Toxoptera aurantiae* Boyer on mamey at Ciales (602–21); attending *Sipha flava* Forbes on sugar cane (330–12) and *Aphis setariae* Thos. on sugar cane (92–13); with *Liburnia* sp. on Guinea grass (108–12); carrying off dead insects (63-10). Attracted by juice from freshly-cut sugar cane (720-12), of corn (331–21), of bean (784–14); injuring corn (154–11), eggplant (180–16, 483–16); at base of palm (342–21); in tobacco seed beds at Caguas (24–10).

Solenopsis globularia F. Smith, var. **borinquenensis** Wheeler 08–131, TYPE of var. from El Morro at San Juan, Porto Rico, and from Culebra Id.
Wheeler: nesting "in the white sand of the sea-beaches just above high-water mark." Illustration of worker.
Wetmore 16–93: eaten by Thrush.

Solenopsis corticalis Forel
Wheeler: in the stem of a bamboo at Utuado.

Solenopsis picea Emery
Wheeler: under bark of rotten log at Utuado.

Solenopsis azteca Forel, var. **pallida** Wheeler 08–131, TYPE of variety from Coamo Springs, Porto Rico.
Wheeler: "a small nest under a boulder in a dry stream bed."

Cremastogaster victima F. Smith, var. **steinheili** Forel
Wheeler: "common — under bark or in hollow twigs." Sheds built over coccids on leaves of *Cordia macrophylla* by colonies at Culebra Id.
Wheeler 10–223: construction of "carton nests" on Culebra Id.
attending mealy-bugs on *Croton* at Yauco (600–22); attending *Toxoptera aurantiae* Boyer on mamey at Plantaje (603–22); on cotton at Villalba (609–21); in dead coffee twigs at Guayama (111–21); nesting in old cocoons of *Megalopyge krugii* Dewitz on citrus tree at Fajardo (468–12).

Pheidole fallax jelskii Mayr var. **antillensis** Forel
Wheeler: at many places in Porto Rico and on Culebra Id.
Van Z. (P. R. 1018).
Wetmore 16–91, 93, 119: eaten by Mockingbird, Thrush and Mozambique.
nesting under cement walk (159–11); nesting in cane field and attacking live changa, *Scapteriscus vicinus* Scudder, at Sardinera, Toa Baja (163–20); attacking live female wasp, *Campsomeris dorsata* Fabr. at Yauco (135–21).

Pheidole megalocephala Fabr.
Wheeler: at many places in Porto Rico, and on Culebrita Id.
Wheeler 10–155: absent in Culebra Id., abundant in Culebrita.
Van Z. (P. R. 1020).
attending *Pseudococcus* sp. (609–12), attacking caterpillars (736–19), driving away *Solenopsis geminata* Fabr. (GNW).

Pheidole subarmata Mayr, var. **borinquenensis** Wheeler 08–133, TYPE of variety from Porto Rico.
Wheeler: "only a few soldiers and workers in a colony — in sandy, sunny places like roads and creek bottoms." Illustrations of soldier and worker.
Wheeler 10–99: same illustrations.
Wetmore 16–129: eaten by Grasshopper Sparrow.

Pheidole flavens sculptior Forel
Wheeler: a single soldier at Coamo.

Pheidole flavens exigua Mayr
Wheeler: redescribed. "Colonies — under logs and stones in open woods and cafetals." At Utuado and Coamo.
on Inga vera at Cayey (619–22).

Pheidole moerens Wheeler 08–136, TYPE from Utuado, Porto Rico, from under stones and prostrate plantain trunks in the woods and cafetals. Illustrations of soldier and worker.

Macromischa isabellae Wheeler 08–138, TYPE from Monte Morales and Monte Mandios, Porto Rico, from colonies under the roots of an epiphytic orchid and in a hollow twig. Illustrations of workers.

Wheeler 10–128: same illustrations.
Wolcott 23–57: on coffee.
in mountains north of Yauco on coffee (405–21), on *Inga vera* (611–22), nesting in old stump (608–22).

Macromischa albispina Wheeler 08–139, TYPE from Culebra Island, one colony in the ground in the shade of a thicket. Illustrations of workers.
Wheeler 10–128: same illustrations.

Tetramorium guineense Fabr.
Wheeler: on Culebra Id., eating papaya, *Carica papaya,* fruit.
Van Z. (P. R. 1016).
in tunnel of *Diatraea saccharalis* Fabr. in sugar cane at Yabucoa (65–13 det. Wheeler).

Tetramorium (Tetrogus) simillimum F. Smith
Wheeler: under stones and logs on the beach of Culebra Id., and in the creek bottom at Coamo Springs.
entering small holes in the buds of sugar cane (152–20 det. Mann).

Wasmannia auropunctata Roger
Wheeler: "common — under stones, prostrate plantain trunks or logs in shady places," on Culebra Id., and at many points in Porto Rico. Illustration of worker.
Van Dine 13–30: attending *Pseudococcus sacchari* Ckll. on sugar cane.
Van Dine 13–33; Jones 15b–15: attending *Sipha flava* Forbes on sugar cane. Colón 19–30: mention. Van Z. (P. R. 321).
Wetmore 16–75, 87, 101, 108: eaten by Swift, Swallow, Oven-Bird and Parula Warbler.
Van Zwaluwenburg 17a–515: reported to occasionally kill out and displace colonies of "hormiguilla" in coffee groves.
attending *Pseudococcus sacchari* Ckll. on sugar cane (181–11, 205–11, 596–12); attending *Pseudococcus citri* Risso on coffee at Ciales (600–21) attending *Sipha flava* Forbes on sugar cane (331–12); on coffee at Yabucoa (606–22), at Quebradillas (616–22), known in coffee groves as *"albayalde."*

Strumigenys rogeri Emery
Wheeler: under stones in stream bed at Coamo Springs. Illustration of worker.
Wetmore 16–119: eaten by Mozambique.

Strumigenys louisianae Roger, var. **obscuriventris** Wheeler 08–145, TYPE from Coamo Springs, Porto Rico, colonies in dry stream bed. Illustration of worker.
Wheeler 10–132: same illustration.

Atta (Trachymyrmex) jamaicensis Ern. Andre
Wheeler: from Culebra Id., and reference to ——.
Wheeler, Wm. M., "The Fungus-growing Ants of North America," Bull. Amer. Mus. Nat. Hist., Vol. 23, No. ----, pp. 669–807, pl. xlix–liii, fig. 31, 1907.

Atta (Mycocepurus) smithi Forel, var. **borinquenensis** Wheeler 07–----, TYPE from Porto Rico.
Wheeler: from many points in Porto Rico.
Wheeler 10–320: Illustration.

Cyphomyrmex rimosus Spinola **minutus** Mayr
Wheeler 07–---: Wheeler 10–319: Illustration.
Wheeler: from Culebra Id., and many points in Porto Rico.
Wetmore 16–101: eaten by Oven-Bird.
(615–22), nesting under cow dung (269–12), under rotten log of *Erythrina glauca* at Cayey (617–22).

Myrmicocrypta brittoni Wheeler 07–----, TYPE from Porto Rico:
Wheeler: at Santurce. Wheeler 10–318: Illustration.

DOLICHODERINAE.

Tapinoma melanocephalum Fabr.
Wheeler: "nesting under stones and under the bark of trees" at many places in Porto Rico, and on Culebra Id.
attacking live insects (110–21), carrying off dead insects (456–12); nesting under board on ground (163–13).

Tapinoma littorale Wheeler
Wheeler: "in hollow twigs of trees and bushes" at Monte Morales and Monte Mandios.

Dorymyrmex pyramicus Roger, var. **niger** Pergande
Wheeler: "common in sandy and sunny places" in Porto Rico, but not in Culebra Id.

Iridomyrmex melleus Wheeler 08–151, TYPE from mountains of Porto Rico. Common in mountains, arboreal, nesting in hollow twigs, or building "carton" nests at base of leaves of "ortegón", *Coccoloba rugosa*, at Utuado, which are not aphis sheds. Illustrations of workers and "carton" nests.
Wheeler 10–223: construction of "carton" nests.
Wolcott 23–57: on coffee.
on coffee trees, nesting in hollow twigs, or in bark in crotch, or between crossing limbs, and often building "carton" nests over colonies, at Guayama (605–21), at Corozal (606–21), at Adjuntas (607–21, 608–21), and in cocoon of *Megalopyge krugii* Dewitz (610–21), at Aibonito (611–21).

Iridomyrmex melleus var. fuscescens Wheeler 08–153, TYPE of variety from Monte Morales and Monte Mandios, Porto Rico, at the summits of the mountains.
on cotton at Boquerón (601–23 det. More).

CAMPONITINAE.

Brachymyrmex heeri Forel

Wheeler: "small colonies under stones" at Santurce and Utuado, and on Culebra Id.

Van Z. (P. R. 153).

Brachymyrmex heeri var. **obscurior** Forel

Wheeler: at Santurce.

Van Dine 13a–32: Jones 15b–15: attending *Sipha flava* Forbes on sugar cane. Colón 19–30: same data.

Van Z. (P. R. 317).

attending *Sipha flava* Forbes on sugar cane (332–12).

Prenolepis longicornis Latreille

Wheeler: "very common in houses, gardens and fields" in Porto Rico and on Vieques Id.

Jones 15–10: digging up lettuce seeds.

in house (134–11); on *Inga vera* at Yauco (610–22); carrying tobacco seed from seed beds at Caguas (25–10); nesting at base of coconut palm fronds on the beach at Mameyes, attending mealybugs and *Orthezia insignis* Douglas on *Lantana camara* (335–22).

Prenolepis vividula Nylander

Wheeler: from Culebra Id., Utuado and mountains of Porto Rico.

on coffee at Utuado (155–20), on *Inga vera* at Utuado (156–20); on banana, nesting in stem, at Maricao (157–20 det. Mann).

Prenolepis steinheili Forel

Wheeler: at Adjuntas and Santurce.

Prenolepis fulva Mayr

Van Z. (P. R. 1021).

attending *Pseudococcus sacchari* Ckll. on sugar cane at Humacao (57–10 det. Wheeler).

Myrmelachista ambigua Forel, subsp. **ramulorum** Wheeler 08–155, TYPE from Arecibo and Utuado, Porto Rico, and Culebra Id., in hollow twigs of sea-grape, *Coccoloba uvifera*, and "torchuelo", *Bucida buceros*. Illustrations of worker.

the "*hormiguilla*" of coffee groves in Porto Rico.

McClelland, T. B., "Report of the Assistant Horticulturist" *in* Ann. Rept. P. R. Agr. Expt. Station at Mayagüez, 1911, p. 30, Washington, D. C., Sept. 3, 1912: in three months driven from coffee when old infested shade trees, *Inga laurina*, are cut down.

Hooker 13–34; on guama and coffee trees, feeding on honey dew from a mealybug, *Pseudococcus citri* Risso, and a large fleshy, pink scale of the sub-family Coccinae. Injury and unsuccessful control measures.

Van Zwaluwenburg 15–33: unsuccessful methods of control.
McClelland, T. B., "Report of the Assistant Horticulturist" *in* Ann. Rpt. P. R. Agr. Expt. Station at Mayagüez, 1913, p. 23. Washington, D. C., May 28, 1914: control by pruning young growth of coffee shade trees, *Inga laurina*, and banding with tree tanglefoot.
Van Zwaluwenburg 16–42: desirable coffee shade trees, not attractive to the "hormiguilla" not found.
Van Zwaluwenburg 17–515: the most complete and extended account of the "hormiguilla" as a pest of coffee.
Van Z. (601) attending undetermined pink *Coccus* in twigs of *Inga laurina*.
Wetmore 16–63: eaten by Woodpecker.
Wolcott 21–48: notes.
Ferris, G. F., "Notes on Coccidae IX. (Hemiptera)" *in* Canadian Entomologist, Vol. 54, No. 7, July, 1922, p. 160: description of the coccid, attended by the "hormiguilla," as *Cryptostigma ingae*.
Wolcott 23–58: host trees: attending *Cryptostigma ingae* Ferris and preliminary experiments in control with poisoned bait.

nesting in sea-grape, *Coccoloba uvifera*, attending a mealybug at Loíza (607–22); nesting in twin tree of *Ficus laevigata* in Ciales valley south of Manatí (621–22); on coffee, guava, *Inga vera*, and guama, *Inga laurina*, throughout the coffee districts, at Utuado (153–20), at Lares (154–20), at Yauco (396–21), at Cayey (618–22).

Camponotus ustus Forel
Wheeler: "in the hollow twigs of sea-grape, *Coccoloba uvifera*," at San Juan and Utuado, in Culebra Id., "nesting in the ground under a block of beach-worn coral."
Wetmore 16–63: eaten by Woodpecker.

in old stump at Utuado (159–20), at San Sebastián (115–21); in dead twigs of *Inga vera* at Utuado (158–20), at Ciales (600–23); in coffee at Lares (640–21).

Camponotus sexguttatus Fabr.
Wheeler: on Culebra Id., in twigs of sea-grape, illustration. At San Juan, and Fajardo (Busck), on flowers of *Serjeania lucida* at Coamo.

Camponotus cuneiscapus Emery
Van Z. (P. R. 620).

SERPHOIDEA.

SCELIONIDÆ.

Prophanurus alecto Crawford—det. Gahan
Wolcott 22e–24: a parasite of the eggs of *Diatraea saccharalis* Fabr., notes, a short description and illustration of adult.

from eggs of *Diatraea saccharalis* Fabr. (234–21), at Toa Baja (336–21).

Phanurus flavus, Dodd, Alan P., "A New Proctotrypoid Egg-parasite from the West Indies (Hym.)" *in* Entomological News, Vol. 25, p. 350, October, 1914, TYPE from Porto Rico.

from eggs of *Ormenis pygmaea* Fabr. 360–12 TYPE), a common parasite.

Telenomus monilicornis Ashmead

Tower 08–35; Tower 10–27; Wolcott 22c–8: from eggs of *Phlegethontius sexta* Johan.

CHALCIDOIDEA.

CHALCIDIDÆ.

Chalcis incerta Cresson

(as *C. annulata* Fabr) Barrett 06–23: from pupae of *Alabama argillacea* Hübner.

Gundlach (det. Cresson).

(as sp.) Wetmore 16–89: eaten by Martin.

Van Z. (5020) from pupae of *Pieris monuste* Linn. and *Megalopyge krugii* Dewitz. (additional records from Mayagüez Station specimens in the National Museum supplied by Mr. Rohwer: from *Calpodes ethlius* Cramer and *Aletia (Alabama) argillacea* Hübner (O. W Barrett) det. Crawford.)

adult swept from grass (79–12); reared from *Mesocondyla concordalis* Hübner (693–17); from chrysalis of *Eantis thraso* Hübner at Lares (406–22); from pupae of *Alabama argillacea* Hübner at Camuy (208–22), at Boquerón (24–23), in the latter case, of a large number of pupae collected, all were parasitized, and this parasite was undoubtedly responsible for checking the extensive outbreak.

(**Chalcis restituta** Walker

Gundlach: "con duda" det. Cresson.)

Chalcis robusta Cresson

Gundlach: "de los contornos de Mayagüez." Ashmead

one specimen reared from *Mocis repanda* Fabr. at Boquerón (341–23).

Chalcis robustella sp. nov.

(as *C.* near *robusta* Cresson) Jones & Wolcott 22–49: from *Remigia repanda* Fabr.

Differs from *C. robusta* Cresson in having basal portion of [illegible] black and posterior femora all black except outside [illegible] anterior distal quarter, and a small dim spot of yellow at [illegible] base.

Black, robust, clothed with short golden-yellow pubescence. Head as broad as prothorax, densely and deeply punctured, with a deep depression in the middle of the face for the reception of the polished and pubescent scape of the antennae, the flagellum robust, dull, greyish, somewhat tapering at ends and slightly constricted at joints. Ocelli reddish-brown. Tho-

rax densely and somewhat more coarsely punctate, pronotum margined vertically at anterior lateral angles Scutellum produced behind, densely pubescent at tip and at sides near base. Tegulae bright yellow, wings subhyaline.

Anterior femora except at base, most of median femora except for an elongate black area at base extending on upper side one-half to two-thirds the distance to the apex, tibiae, except for base of posterior pair, and tarsi except claws and two final segments of posterior pair, bright yellow. Posterior femora much swollen and all black except for a bright yellow spot on outside and anterior distal quarter, and a small dull yellow spot at base, posterior margin armed with ten or eleven obtuse teeth, largest at base, smaller and more thick-set towards apex. Abdomen subsessile, robust, convex, flattened beneath, ovate, bluntly pointed at tip, smoothly polished and with posterior margins of apical segments faintly punctate and more or less fringed with golden and silvery pubescence. Length 6.5 — 8 mm.

from cocoons of *Megalopyge krugii* Dewitz (38–21 TYPE); from pupae of *Remigia repanda* Fabr at Guánica (656–14, the yellow spot on posterior femora of these specimens extends over half way towards the base on the anterior margins, also to the apex, and the tibiae are all yellow); from *Neonympha* pupa at Guánica, parasitized July 25, 1:42 PM, adult issued Aug. 6, 4:00 PM (E. G. Smyth), (approaching *C. incerta* Cresson, with silvery pubescence and small areas of black appearing on the tibiae, but the yellow areas are bright and intense); resting on *Conocarpus erectus* at Arecibo (361–23).

Spilochalcis femorata Fabr.

Van Z. (P. R. 49). (as sp.) Wetmore 16–61: eaten by Ani.

swept from grass at Morovis (GNW), from carrots (549–17, 691–17), on corn at Guánica (431–14); reared from *Pachyzancla bipunctalis* Fabr. (655–16).

Spilochalcis syrphidis sp. nov.

Yellowish-ferrugineous. Antennae inserted in middle of face, scape slender and a little longer than the height of the head, funicle about twice as long, darker, faintly pubescent and of uniform thickness. Head wrinkled and shagreened, faintly pubescent, concave behind, eyes prominent, olive brown, ocelli large, prominent, shining, reddish-brown. Thorax shagreened. Pronotum lighter yellow, narrow dorsally and margined posteriorly with black, becoming somewhat wider towards the sides and unmargined. Mesothorax with a piceous longitudinal medio-dorsal line, often extending to the middle of the scutellum, and more or less piceous or black laterally and ventrally, between and in front of insertion of the legs, the anterior margin of the episternum always piceous or black, contrasting sharply with the light-yellow anterior and median pair of legs. Pos-

terior coxae shining, finely pitted on the outside, almost as large as the much-swollen and more pubescent femora, which on the distal two-thirds of their lower margins bear over 20 small black blunt teeth, the first largest, the others sub-equal in size, except the somewhat smaller and more closely-set apical five or six. Wings brilliantly hyaline. Petiole of abdomen, light-yellow and slender, with a foliate collar distad of the narrow constriction at base. Abdomen ovate, bluntly pointed at ends, shining, distal margins of its segments sparsely cilliate.

from puparia of Syrphid flies, *Toxomerus polygonastyla* Metcalf MS, on tobacco at Caguas (121–21 TYPE), swept from carrots (690–17).

Spilochalcis cocois sp. nov.

Yellowish-green (in faded specimens dark reddish), pubescent and coarsely pitted on head and thorax. Head, with eyes each as wide as front, black around insertion of antennae, behind scape to ocelli, and posteriorly; insertion of antennae below middle, scape yellow, flagellum black, pubescent, of uniform width throughout. The segments of the thorax above more or less margined with black and their more elevated portions tending to be piceous or black, especially the scutum, which has a broad, median, longitudinal oval band; beneath black, except for spots on the metapleurum and epimerum with long pubescence; the propodeum with several large, deep, irregularly-polygonal craters, a short tooth, dorso-lateral of the pedicel, at one point on their margins. Pedicel light yellow, short, only as long as from insertion to scultel; abdomen large, smooth, shining, oval, scantily pubescent, blunt at base, with an elongate, pointed tip recessed beneath posteriorly, black at base, on posterior margins dorsally of other segments and on entire posterior quarter except for a semi-circular spot dorsally on the sixth segment. Posterior coxae finely reticulate and with a large black spot on the flattened surface where the femora fold against them, elsewhere pubescent; femora black at base and apex and with a spot on upper margin, dilated and with 15–16 small, black teeth on lower margin, the more basal one not much larger than the others; tibiae black at base and with a round black spot on middle, lighter yellow than the femora, but not quite as light as tarsi, the apical spur, long, curved and sharply-pointed two-thirds as long as tarsi. Wings, clear, hyaline, veination brown, yellow at base. Length 4 mm.

from coconut palm leaves infested with *Homaledra sabulella* Chalmbers (106–23).

Spilochalcis homledrae sp. nov.

Black, head and thorax roughly and shallowly pitted, the pits on scutel and metapleura larger and shallower, with whitish pubescence. Head beneath, about half-way up behind eyes and

in front along their margins nearly to top, light yellowish-green, but much darker in old specimens; insertion of antennae low, scape largely or entirely light yellow, flagellum as long as height of head, black, densely pubescent, slightly narrower towards base. Pronotum dorsally, sides of scutel, pedicel of abdomen, anterior and median pairs of legs and posterior tarsi light yellowish-green, becoming browner in old specimens. Below the base of the pedicel, a pair of large, sharp teeth, deeply hollowed out beneath and laterally. Pedicel as long as scutel, about half as long as abdomen; abdomen shining, faintly pubescent, more taperingly pointed at apex. Posterior coxae faintly crenulate, shining, scantily pubescent; femora black or piceous, densely pubescent, a small yellow spot near the apex on the outside and an elongate band along upper margin, the large basal tooth on ventral margin reddish-brown, the twelve other smaller teeth black, from the fifth tooth to the apex with rather long white hairs extending beyond them from the inner surface of the femur; tibiae light yellow near base and at apex, black at base and middle, strongly curved and produced into a sharp tooth. Wings transparent, hyaline, veination brown, yellow at base. Length about 3 mm.

from coconut palm leaves infested with *Homaledra sabulella* Chalmbers (137-23).

Smiera cressoni Howard—det. Gahan

from pupa of *Oxyptilus* sp. on *Caperonia regalis* (588-12)

Smiera emarginata Fabr.

Gundlach, "rara." Ashmead. Dewitz.

Smiera (Tetrasmiera) eubule Cresson

Van Z. (P. R. 59).

from pupa of *Callydrias eubule* Linn. (160-12), at Guánica (202A-15). (160-12) differs from Cresson's description in that all markings on thorax and legs are black, and in addition has a black petiole to the abdomen, but (202A-15) has some of its markings ferruginous and the petiole is yellow, and as they are from the host recorded by Cresson, probably represent a more melanic variation of the Cuban species.

Smiera flavopicta Cresson

Gundlach, "común." Ashmead. Dewitz.

Smiera ignea Cresson

Gundlach, "rara." Ashmead. Dewitz.

Smiera punctata Fabr.

Gundlach, "Las larvas de todas las especies de esta familia se crían dentro del cuerpo de orugas y larvas, o crysálidas y ninfas."

Dewitz.

PERILAMPIDÆ.

Perilampidea larium sp. nov.

Head, blue-black, irridescent, pitted and covered with short white hairs, thorax blue becoming purplish and greatly expanded between the wings, abdomen small and bright irridescent green, legs light-yellow. Wings transparent, pinkish irridescent.

from pupa of *Baccha clavata* Fabr. at Lares (428-21, TYPE in National Museum.)

EURYTOMIDÆ.

Eurytoma ctenodactylomyii Girault, A. A., Ins. Insc. Menstruus, Vol. 4, 1916, p. 111: from galls in sea-grape, *Coccoloba uvifera*, of *Ctenodactylomyia watsoni* Felt, TYPE from Porto Rico.

EUPELMIDÆ.

Lecaniobius cockerellii Ashmead

Ashmead 00-341:

Tanaostigmodes portoricensis Crawford 13-247, TYPE form Porto Rico.

Van Z (P R 1623) from seed pods of *Inga laurina.*

ENCYRTIDÆ.

Hunterellus hookeri Howard—det. Crawford

from tick, *Dermacentor nitens* Neuman (358-12); running about in hairs of dog (707-13).

Arrhenophagus chionaspidis Aurivillius—det. Girault

Jones 17-8, 11: from *Hemichionaspis minor* Maskell and *Saissetia nigra* Nientn. (321-12).

Coccidoxenus portoricensis Crawford 13-249, TYPE from Porto Rico.

Jones 17-2: from *Ceroplastes cistudiformis* Comst.

Tabrolepoidea oelia Girault, A. A., TYPE from Porto Rico.

from puparium of syrphid fly, *Baccha latiuscula* Loew (143-17), at Pt. Cangrejos (GNW).

APHELINIDÆ.

Aspidiotiphagus citrinus Crawford

Carnes, E. K., "Report of the Insectary Division for the Month of May, 1912," *in* Monthly Bull. State Comm. Hort., Sacramento, California, Vol. 1, No. 8, 1912, pp. 395-400: "From Prof. C. W. Hooker, Mayagüez, Porto Rico. First shipment: *Lepidosaphes beckii, Chrysomphalus aonidium. Aspidiotiphagus citrinus* issued in considerable numbers. Second shipment: same material. Very few *A. citrinus* issued."

Jones 17-9: from *Chionaspis citri* Comst.

Aphelinus chrysomphali Mercet—det. Gahan
Jones 17–11: from *Aspidiotus destructor* Sign., det. Dr. Howard as "apparently my *Aphelinus diaspidis.*"
from *Aspidiotus destructor* Sign. (652–21) and adults abundant on infested coconut leaves.

Encarsia portoricensis Howard, L. O., 07–77: "from *Aleyrodes* sp. on a climbing vine, Bayamón, Porto Rico, reared by Mr. A. Busck," TYPE from Porto Rico.
Van Z. (5022) from *Aleyrodes* sp.

Perrisopterus busckii Howard, L. O., "New Genera and Species of Aphelininae," U. S. Dept. Agr., Bur. Ent., Technical Series, No. 12, pt. 4, July 12, 1907, p. 87: "from *Asterolecanium aureum* Boisduval, collected at San Juan, Porto Rico, Feb. 21, 1899, by A. Busck.", TYPE from Porto Rico.

SPALANGIDÆ.

Spalangia sp.—det. Crawford
Wolcott 22d–18: reared from horn-fly pupae at Guánica by G. B. Merrill.

PTEROMALIDÆ.

Neocatolaccus filia Girault, A. A. (MS name)
from pupa of *Agromyza caerulia* Malloch in seeds of morning glory (142–17).

Neocatolaccus near **filia**—det. Girault
from pupae of Agromyzid fly in seeds of *Sida rhombifolia* at Mayagüez (242–17).

Neocatolaccus livii Girault, A. A., Ins. Insc. Menstruus, Vol. 4, 1916, p. 111; reared from galls in sea-grape, *Coccoloba uvifera,* of *Ctenodayctylomia watsoni* Felt, TYPE from Porto Rico.

Pteromalus calandrae Howard
Barrett 05–396: "a common parasite of the rice weevil, *Calandra oryzae.*"

EULOPHIDÆ.

ELACHERTINAE.

Ardalus antillarum Gahan, A. B., Proc. U. S. National Museum, Vol. 61, Art. 24, No. 2445, p. 20, 1922: "from larvae of *Prenes nero* Fabricius, May 10, 1921", TYPE from Caguas, Porto Rico.
Jones & Wolcott 22–41: "The larvae — issue from the caterpillars and form naked black pupae nearby, sixteen individuals having been observed to come from one large larva."
(10–13) from larva of *Prenes nero* Fabr.

Euplectrus sp.—det. Gahan
Wolcott 21–38: on larva of *Laphygma frugiperda* S. & A.
Jones & Wolcott 22–44: on *Cirphis latiuscula* Herr. Sch.
on larvae of *Cirphis latiuscula* H. S. (23–13, 39–13), of *Xylomiges sunia* Guenee (576–17), of *Autographa rogationis* Guenee (303–16).

Zagrammosoma multilineata Ashmead—det. Ashmead
Barrett 06–22: a "rare parasite, strictly primary" of *Leucoptera coffeella* Stainton, the coffee leaf-miner.
Van Zwaluwenburg 15–33; Van Zwaluwenburg 17–514: mention.
Wolcott 21a–8: illustration of adult, notes.

Zagrammosoma sp.—det. Gahan
with two dorso-lateral black stripes on the thorax, the more dorsal becoming broader on the abdomen, the other fainter and interrupted.
from mines of *Leucoptera coffeella* Stainton on coffee at Lares (152–21).

EULOPHINAE.

Diaulinus insularis Gahan, A. B., Proc. U. S. National Museum, Vol. 48, Dec. 16, 1914, p. 165: from *Agromyza inaequalis* Malloch, TYPE from Porto Rico.

ENTEDONTINAE.

Chrysocharis livida Cresson
Barrett 05–397: a parasite of *Leucoptera coffeella* Stainton, the coffee leaf-miner, at Mayagüez. "black with purplish reflections from the thorax; the size about 1 mm.: it is very active."
Barrett 06–22: "throughout the island."
Van Zwaluwenburg 15–33: 30% of the pupae of *L. coffeella* parasitized at Mayagüez.
Van Zwaluwenburg 17–514: mention.
Wolcott 21a–8: illustration of adult, notes.

Horismenus pteromalis
Van Z. (5024) from undetermined sphingid.

Horismenus sp.—det. Crawford
from seed pods of *Acacia farnesiana* infested with *Bruchus* sp. at Guánica (43–14), from pods of *Prosopis juliflora* (45–14).

TETRASTICHINAE.

Tetrastichus hagenowi Ratz.—det. Crawford
Seín 23–5: as a primary parasite of *Periplaneta americana* Linn. egg masses, notes.
71 individuals from one egg capsule (409–12, 333–22 det. Gahan).

Tetrastichus periplanetae Crawford—det. Gahan
from egg capsule of cockroach (343–21).

Tetrastichus vaquitarum sp. nov.
Head yellow, piceous behind, eyes and ocelli chestnut red, antennae dark yellow, with many long yellow hairs. Thorax shining blue-black, mesonotum with median longitudinal sulcus, very distinct and the scutellum divided into approximately three equal parts by two such longitudinal impressed lines. Abdomen flattened dorso-ventrally, prolonged to an acute tip, yellow, except the three post-median segments dorsally which are piceous. Legs light yellow with tips of tarsi black, wings hyaline and pinkish irridescent, with many short hairs, veins very light brown. Length 1 mm.
from eggs of *Lachnopus coffeae* Marshall in the mountains north of Yauco (153–21 TYPE).
Van Zwaluwenburg 17–515: "A Chalcid has been bred from what appeared to be the egg cluster of this insect." (*Lachnopus coffeae* Marshall).
(as sp. — det. Gahan). Wolcott 22a–17: illustration of adult and notes.

TRICHOGRAMMIDÆ.

Brachistella prima Perkins—det. Girault
from eggs of *Kolla similis* Walker on sugar cane (335–12).

Ufens niger Ashmead—det. Girault
from eggs of *Kolla similis* Walker on sugar cane (335–12).

Oligosita comosipennis Girault—det. Girault
from eggs of *Kolla similis* Walker on sugar cane (335–12).

Aphelinoidea semifuscipennis var. **albipes** Girault—det. Girault
from eggs of *Liburnia* sp. on *Paspalum* sp. (126–12).

Poropoea attelaborum Girault—det. Gahan
Wolcott 22a–7: mention.
from eggs of *Attelabus sexmaculatus* Chevrolat (GNW).

Trichogramma minutum Riley—det. Girault
Van Dine 13–29; Van Dine 13–254; Colón 19–42; Smyth 19–144: from eggs of *Diatraea saccharalis* Fabr.
Wolcott 15–2: less abundant in cane fields where trash has been burned as indicated by higher infestation of cane by *Diatraea saccharalis* Fabr.
Jones 15c–14: notes and illustration of parasitized eggs.
Wolcott 22e–24: notes, short description and illustration of adult.
Jones & Wolcott 22–41: from eggs of *Prenes nero* Fabr.
Jones & Wolcott 22–42: from eggs of *Prenes ares* Felder.
Van Z. (5088) from eggs of *Diatraea saccharalis* Fabr.

from eggs of *Diatraea saccharalis* Fabr. at Guánica (112-11, 506-12, 172-13); from eggs of *Prenes ares* Felder (1222-13), of *Pachyzancla periusalis* Walker (624-17, 546-17); on canna leaves, parasiting eggs of *Calpodes ethlius* Cramer at Pt. Cangrejos (190-15).

MYMARIDÆ.

Anagrus armatus Ashmead—det. Girault
Jones 14-463: from eggs of *Delphax saccharivora* Westw.
from eggs of *Saccharosydne saccharivora* Westw. on sugar cane (208-11), from eggs of *Liburnia* sp. on *Paspalum* sp. (126-12).

CYNIPOIDEA.

FIGITIDÆ.

Ganaspis hookeri Crawford 13-244, TYPE from Porto Rico.
(as sp.) Hooker 13-36: attacking the larvae of *Anastrepha fraterculus* Wied. in fruit of *Spondias lutea.*

Xyalosema (Aspicera) bifoveolata Cresson—det. Crawford
Wolcott 22d-18: from horn-fly pupae at Guánica (G. B. Merrill).

ICHNEUMONOIDEA.

ICHNEUMONIDÆ.

(The generic transfers in this family were made by Mr. R. A. Cushman.)

Tetragonochlora meridionalis Cresson
(as *Ichneumon*) Stahl.

Acrorienus cubensis Cresson—det. Cushman
reared from nest of *Eumenes ornatus* Saussure (290-23).

Hemiteles subflavescens Cresson
Stahl.

Lissonota sp.—det. Cushman
from *Agathodes designalis* Guenee (409-22).

Christolimorpha incertus Cresson
(as *Hemiteles*) Gundlach. Aldrich.
a male from Morovis (GNW) is apparently this species, a female from Ciales (GNW) similar, but has only "posteriorly a small white spot, elevated into a subacute tubercle" of *H. amoenus* Cr., not the "long, porrect, acute spine" of *H. incertus* Cr., and in other ways, more or less combines characters of the two species.

Christolimorpha plesius Viereck 13-564, TYPE from Porto Rico.

Ephialtes marginella Brulle
(as *Pimpla*) Stahl. Gundlach. Ashmead.

Tromatobia (Ephialtes) cressoni Dewitz 81–205, TYPE from Mayagüez, Porto Rico.
(as *Ephialtes*) Gundlach.
14 males and 2 females from a cluster of spider eggs at Lares (324–21 det. Cushman), 1 female in coffee grove (49–21).

Theronia bicincta Cresson
(as *Pimpla*) Stahl.

Theronia (Pimpla) nubecularia Dewitz 81–206, TYPE from Mayagüez, Porto Rico.
(as *Pimpla*) Gundlach.

Eremotylus angulatus Hooker 12– , TYPE from Porto Rico.
Van Z. (5037) from larva of *Ecpantheria eridanus* Cramer.
Van Zwaluwenburg, R. H., Ins. Insc. Menstruus, Vol. 4, 1916, p. 17: same data.

Tryphon cerberus Dewitz 81–206, TYPE from Porto Rico.
Gundlach.

Enicospilus arcuatus Felt—det. Cushman
from Aibonito (SSC).

Enicospilus concolor Cresson
Van Z. (P. R. 1028).
abundant in grass (415–17 det. Cushman).

Enicospilus flavus Fabr.
(as *Ophion*) Stahl. Gundlach, "común."
Van Z. (P. R. 1027).

Enicospilus purgatus Say
Van Z. (P. R. 1029).

Enicospilus thoracicus Cresson
(as *Ophion*) Gundlach.
Van Z. (5083) from *Phlegethontius sexta* Johan.
Wolcott 22c–8: same data.

Ophion bilineatus Say
Hooker 12–45:
from Guánica (GBM).

Ophion biangularis Taschenberg
Van Z. (P. R. 1026).

(**Ophion bicarinatus** Cresson MS TYPE from Mayagüez, Porto Rico.
Gundlach.)

(**Ophion obsoletus** Cresson MS TYPE from Porto Rico.
Gundlach.)

Ophiopterus ferrugineus Cresson
Hooker 12–176, b & c:

Xiphosoma annulata Cresson
Dewitz. Stahl. Gundlach, "en Utuado." Ashmead.
swept from weeds (139–17), from carrots (692–17 det. Cushman); from cane at Guánica (102–13, 430–14); "reared from leaf-roller larva." E. G. Smyth.

Xiphosoma (Brachixiphosoma) insularis Viereck 13–564, TYPE from Porto Rico.

Xiphosoma nigrovittata Cresson
Dewitz. Gundlach. Ashmead.
swept from carrots (692–17), and unlabeled specimen.

Xiphosoma vitticollis Cresson
from Guánica (444–14 det. GNW).

EVANIIDÆ.

Evania appendigaster Linn.
(as *E. laevigata* Oliv.) Dewitz. Gundlach, "Se encuentra muchas veces en las casas, donde la larva se cría en las oötecas de las cucarachas."
Seín 23–5: notes and illustration of adult.
from eggs of cockroaches (168–15), at Arecibo (445–13), at Guánica (445–14).

Evania ruficaput Dewitz 81–205, TYPE from Mayagüez, Porto Rico.
Gundlach.

Hyptia petiolata Fabr.
Dewitz. Gundlach. Ashmead.

Hyptia rufipectus Dewitz 81–205, TYPE from Mayagüez, Porto Rico.
Gundlach.

BRACONIDÆ.

Rogas sp. nov.—det. Gahan
Jones & Wolcott 22–49: from *Remigia repanda* Fabr.
at Guánica (429–13).

Homalotylus obscurus
Jones 156–12: parasitic on *Cycloneda sanguinea* Linn. and *Megilla innotata* Vauls.

Aphidius (Lysiphlebus) testaceipes Cresson
Jones 14–462, Jones 15b–17: as parasite of *Aphis setariae* Thos.
Colón 19–30: same data.
Wolcott 22–5: illustration of parasitizm of *Toxoptera aurantiae* Boyer on grapefruit.
parasitic on aphids, *Hysteroneura setariae* Thos. on sugar cane (93–13 det. Gahan), *Aphis gossypii* Glover on cucumber (42–12 — det. Viereck), *Toxoptera aurantiae* Boyer on grapefruit (GNW).

Chelonus insularis Cresson
Dewitz. Gundlach. Van Z. (P. R. 61).
Jones & Wolcott 22–47: "The female – – –, after removing a portion of the hairs from the egg cluster (of *Laphygma frugiperda* S. & A.) lays its eggs in the eggs of the moth. Caterpillars from these eggs issue normally, but they contain the maggots of the wasp which kill them before they are more than half-grown. The small caterpillars enter the ground as if to pupate, but soon die, and the cocoons of the parasite will be found within the shriveled remains of the host caterpillar."
adults swept from weeds (27–17), on corn at Aguadilla (26–22); parasitizing eggs of *Laphygma frugiperda* S. & A. at Guánica (91–13); reared from larvae of *Heliothis obsoleta* Fabr. at Caguas (139–11).

Monogonogaster ventralis Cresson
(as *Bracon*) Gundlach. Dewitz.
Van Z. (P. R. 50).

Yelicones sp.—det. Rohwer
from *Tetralopha scabridella* Ragonot on *Inga vera* at Cayey (12–23).

Iphiaulax voraginis Cresson
(as *Bracon*) Gundlach, "en Quebradillas." Dewitz.

Bracon guanicana sp. nov.
Length 6 mm., of ovipositor 3 mm. additional. Shining yellowish-brown, except antennae, veination, posterior tarsi and apical portion of posterior tibiae, and sheath to ovipositor, which are piceous to black. Abdomen above polished and scantily pubescent, rest of body, including ovipositor sheath, finely and densely pubescent, pubescence on the legs being especially dense and long.

Head, pear-shaped, narrowed beneath the eyes, concave below and medially of their lower margin on either side of broad median ridge, twice as high as the eyes and more than twice as broad as an eye between them; ocelli darker, reddish-brown, in slight craters on an elevation at the top of the head, in the male a transverse ridge cuts off the lateral pair from the craters around the insertions of the antennae and the median one, less well marked in the female. Basal joint of antennae reddish-brown, also the base of the much larger and shining second segment; flagellum dull, densely pubescent, its first segment longer than the second, second and third subequal. A median furrow on the mesonotum, the notauli meet behind its disappearance (making a heart-shaped elevation) and extend a short distance behind as a furrow; a pair of deep quadrangular depressions in front of the scutum; dorsal aspect of the propodeum not as shiny, with longitudinal ridges at

sides, a pair in the middle and another pair about midway between, posteriorly connected by several smaller and somewhat obscure transverse ridges. Abdomen brilliantly shining, about as long as thorax but considerably narrower, flattened above and sharply cut away from lateral margins, but more rounding and not margined posteriorly, apical segments darker, especially in the male, sharply bent downward just anterior of the rounded posterior margin of the first segment, which is nearly twice as long as broad at apex, the other segments progressively shorter, the third and fourth the broadest. Ovipositor slightly curved, yellow, covered, except near apex, by pubescent black sheath. Wings dusky, basal half lighter, veination blackish, base of median vein and of stigma lighter, areolet quadrangular, open on lower half of outside margin, directly under stigma.

One male and two females (three other specimens in National Museum) "collected in screen trap in garden" by E. G. Smyth at Guánica (457 — June 30, 1914), generic determination by Mr. Gahan

Crassomicrodus fenestratus Viereck 13–559, TYPE from Porto Rico. at Guánica (453–14 det. Gahan).

Microbracon sp.—det. Crawford
Jones & Wolcott 22–42:
from larvae of *Prenes ares* Felder on sugar cane (1205–13), at Luquillo (188–13)

Apanteles aletiae Riley—det. Gahan
from small larva of *Alabama argillacea* Hübner at Hatillo (330–22).

Apanteles leucostigmus Ashmead—det. Gahan
from larva of *Eudamus proteus* Linn. (27–13), at Guánica (634–14).

Apanteles prenidis Muesebeck, C. F. W., "A Revision of the N. A. Species of Ichneumon-Flies belonging to the Genus Apanteles." Proc. U. S. National Museum, Vol. 58, No. 2349, pp. 483–576, 1920; TYPE from Luquillo, Porto Rico, (p. 558), reared from *Prenes ares* Felder.
Wolcott 21–39: from *Prenes nero* Fabr.
Jones & Wolcott 22–41 & 42: from *Prenes nero* Fabr. & *P. ares* Felder.
from larva of *Prenes ares* Felder at Luquillo (186–13 TYPE); from *Prenes nero* Fabr. (GNW — det. Muesebeck).

Apanteles marginiventris Cresson = **Apanteles grenadensis** Ashmead — det. Gahan.
Jones & Wolcott 22–44 & 47: from *Cirphis latiuscula* H. S. and *Laphygma frugiperda* S. & A.
from *Laphygma frugiperda* S. & A. at Garrochales (GNW).

Apanteles flaviventris Cresson
(as *Protopanteles*) Van Z. (5023) from *Dilophonota ello* Linn.
from sphinx caterpillar, *Erinnyis ello* Linn. (396–12), at Guánica (200–15, 222–15, 372–15).

Apanteles mayaguezensis Viereck 13–563, TYPE from Mayagüez, Porto Rico.
Van Z. (5095).
from sphinx caterpillar on *Cissus sicyoides* (123–21 — det. Gahan).

Apanteles congregatus Say—det. Gahan
from larva of *Protambulyx strigilis* Linn. (22–19).

Opius (Uteles) anastrephae Viereck 13–564, TYPE from Mayagüez, Porto Rico.
Hooker 13–36: attacking larvae of *Anastrepha fraterculus* Wied. in fruit of jobo, *Spondias lutea*. Van Z. (5063).

Opius insularis Ashmead—det. Gahan
from *Agromyza* sp. on *Hyptis pectinata* (1123–16).

ALYSIIDÆ.

Alysia analis Cresson—det. Gahan
in cane fields (80–13, 90–13), at Arecibo (15–15), at Guánica (41–22); in coffee groves at Cayey (371–21), at Ciales (78–22), being caught and killed by *Zelus longipes* Linn. in mountains north of Yauco (44–23).

TENTHREDINIDÆ.

Schizocera zaddachi Dewitz 81–207, TYPE from Porto Rico=

Schizocera krugii Cresson, E. T., Trans. Amer. Ent. Soc., Vol. 8, 1880, p. 54, TYPE from Porto Rico.
Gundlach. Ashmead; **giving both names.**
(as *Sterictiphora zaddachi*) Van Zwaluwenburg 18–28: an extended account, larvae feeding on sea-grape, *Coccoloba uvifera*, and icaco, *Chrysobalanus icaco*.
on sea-grape on the beach at Santurce (35–13), at Hatillo (501–18, 297–22), at Arecibo (GNW).

COLEOPTERA.

LITERATURE.

Chevrolat, Aug. Bull. Ent. Soc. France, Tome VII, Ser. V, 1877, pp. VIII–X.

Weise, J., "Beitrag zur Chrysomeliden und Coccinelliden Fauna von Puertorico." Archiv für Naturgeschichte, Vol. 51, Part. 1, pp. 144–168, pl. viii, 1885.

Quedenfeldt, G., "Neue und seltnere Kafer von Portorico." Berliner Entomologische Zeitscrift, Vol. 30, Part. 1, pp. 119–128, 1886.

Leng, C. W. & Mutchler, A. J., "A Preliminary List of the Coleoptera of the West Indies as Recorded to Jan. 1, 1914." Bulletin American Museum of Natural History, Vol. 33, Art. 30, pp. 391–493, New York, Aug. 26, 1914.

Leng, C. W. & Mutchler, A. J., "Supplement to Preliminary List of Coleoptera of the West Indies." Bulletin American Museum of Natural History, Vol. 37, Art. 5, pp. 191–220, New York, Feb. 13, 1917. (Only the original records in this paper are noted in the following list: those from the papers of Gundlach, Van Zwaluwenburg and Jones are omitted, except when listed in synonymy under a different name.)

Dr. E. A. Schwarz, of the U. S. National Museum, has made most of the determinations of Coleoptera on which the original records here given are based, and if determination by him is not always specified, it is usually implied. To him for aid in the preparation of this list, the writer is most greatly indebted. Dr. A. D. Hopkins, of the Bureau of Entomology, has determined the Platypoidae and the Scolytidae, Mr. W. S. Fisher the Buprestidae and some of the Cerambycidae, Mr. R. H. Van Zwaluwenburg the Elateridae, Mr. R. T. Cotton most of the beetles affecting stored grain, and, at the time he was connected with the Bureau, Dr. W. Dwight Pierce some of the Curculionidae. Dr. Pierce also described the only species of Strepsiptera recorded from Porto Rico.

Mr. Andrew J. Mutchler, of the American Museum of Natural

History, determined the Lampyridae and Cantharidae, and to him the writer is most grateful for references to literature not available in Porto Rico and for suggestions (not all of them adopted) regarding the format of the list. Dr. A. B. Wolcott, of the Field Museum at Chicago, described a Clerid from Porto Rico.

Dr. Guy A. K. Marshall, Director of the Imperial Bureau of Entomology, has determined many of the Curculionidae, and has described several new species from Porto Rico. To him the writer is also indebted for obtaining the determinations of several Chrysomelidae by Mr. G. E. Bryant, of Tenbrionidae by Mr. K. G. Blair and of *Lachnosterna* by Mr. E. S. Arrow.

CICINDELIDÆ.

LITERATURE.

Leng, C. W. & Mutchler, A. J., "Descriptive Catalogue of West Indian Cicindelinae." Bulletin American Museum of Natural History, Vol. 35, Art. 36, pp. 681–699, pl. 1, figs. 5, New York, October 17, 1916: illustrations of four Porto Rican species and of alkali flat at Santa Rita (Guánica) where some of them were found.

Tetracha sobrina Dejean, var. **infuscata** Mannerheim
(as *T. infuscata* Chaudoir) Stahl. Gundlach.
Tower, W. V., *in* First Rpt. Bd. Comm. Agr. P. R., Jan. 1, 1912, p. 20: attacking the changa, *Scapteriscus vicinus* Scudder.
Leng & Mutchler. Leng & Mutchler 16–686: notes.
(747–12 det. Schwarz, 1028–16), at Caguas (SSC), at Guánica (–13), at Arecibo (150–16).

Cicindela boops Dejean
Leng & Mutchler 16–691: short description and notes.
at Guánica, December 1913 (EGS).

Cicindela suturalis Fabricius
Leng & Mutchler 16–693: from Porto Rico.

Cicindela suturalis Fabr., var. **hebraea** Klug
(as *C. hebraea* Klug) Stahl. Gundlach.
Leng & Mutchler 16–694: description and notes, at Añasco.
on the beach at Añasco, Sept. 2, 1914 (EGS).

Cicindela trifasciata Fabricius
(as *C. tortuosa* Dejean) Stahl. Gundlach. Van Z. (P. R. 814).
Leng & Mutchler 16–692: notes.
at Guánica, July 1913 (EGS), at Arecibo (147–13), common on sandy banks of stream at Maunabo (658–17), on the beach at Pt. Cangrejos (GNW).

CARABIDÆ.

Calasoma alternans Fabricius
Stahl. Gundlach. Leng & Mutchler.
Van Z. (P. R. 5061) attacking *Remigia repanda* Fabr. and larvae of *Lachnosterna* spp.
Wetmore 16–61: eaten by Ani, *Crotophagus ani.*
Jones 13–235: probably predaceous on larvae of *Laphygma frugiperda* S. & A.
at light (88–21), at Arecibo (150–13), at Cayey (167–16), at Guánica (572–13,. 451A–14), in land being plowed at Guánica (381–21).

Scarites subterraneus Fabricius
Stahl.

Ardistomis mannerheimi Putzeys
Leng & Mutchler.

Aspidiglossa vulnerata Putzeys
(as *A. bipustulata* Fabr.) Stahl. Gundlach.

Morio monilicornis Latreille
Stahl. Gundlach. Leng & Mutchler 17–195.

Pangaeus fasciatus Say
Gundlach.

Pangaeus quadrisignatus Chevrolat
Leng & Mutchler 17–195.
at Aibonito (SSC), at Guánica (det. Schwarz).

Pericompsus bladulus Schaum
Leng & Mutchler.

Bembidium sp.
Wetmore 16–43: eaten by Semipalmated Sandpiper.

Tachys macrodentrus Chevrolat
Gundlach.

Tachys piceolus Laferte
Leng & Mutchler.

Tachys vitiger Leconte
Gundlach.

Trechius substriatus Chevrolat
Gundlach.

Casnonia insignis Chaudoir
Stahl. Gundlach.

Lachnophorus leucopterus Chevrolat
Leng & Mutchler 17–194.

Zuphium americanum Dejean
Gundlach.

Lebia viridis Say
Leng & Mutchler 17–195.
(252–12, 645–17)

Lebia bitoeniata Chevrolat
Leng & Mutchler 17–195.

Apenes marginalis Dejean
(as *Cymindis*) Gundlach, determined by M. Chevrolat.
(195–12, 437–17), at Luquillo (203–13).

Apenes varigata Dejean
Leng & Mutchler 17–195: recorded by Gundlach and Van Zwaluwenburg as *Cymindis* (probably the above).

Rhombodera bicolor Leconte
(as *R. atrorufa* Reiche) Gundlach.
Van Z. (P. R. 802).

Brachinus glivipes Mannerheim
Stahl. Gundlach.

Stenous tibialis Chevrolat
Stahl. Gundlach.
at light at Guánica (640–13 det. Schwarz).

Oodes femoralis Chaudoir
Stahl.

Selenophorus alternans Dejean
Gundlach.

Selenophorus discopunctatus Dejean
Gundlach. Leng & Mutchler 17–194.

Selenophorus flavilabris Dejean
Leng & Mutchler 17–194.

Selenophorus parumpunctatus Dejean
Stahl. Gundlach.
in sea-weed on the beach at Pt. Cangrejos (GNW).

Selenophorus pyritosus Dejean
Stahl. Gundlach.
at light at Guánica (574–13).

Selenophorus sp.
Wetmore 16–39, 61, 91: eaten by Killdeer, Ani and Mockingbird.

HALIPLIDÆ.

Haliplus sp.—det. Schwarz.
at light at Manatí (228–16).

DYTISCIDÆ.

Hyphydus obniger Chevrolat
Gundlach.

Laccophilus proximus Say (o sambi **americanus** Aube) Stahl.
Stahl. Gundlach.

Pachydrus globosus Aube
Leng & Mutchler.

Pachydrus brevis Sharp—det. Schwarz
at light at Vega Alta (162–15).

(**Hydroporus exilis**
Stahl.)

Copelatus angustatus Chevrolat
Gundlach.
(as sp.) Wetmore 16–84, 87: eaten by Wood Pewee and Cliff Swallow.
(676–16 det. Schwarz.)

Thermonectes circumscriptus Latreille
(as *Acilius*) Gundlach.
Wetmore 16–22: eaten by Green Heron.
Leng & Mutchler 17–196: recorded by Gundlach.
in small stream at Espinosa (506–17 det. Schwarz).

Thermonectes margineguttatus Aube
(as *Acilius*) Gundlach.
Leng & Mutchler 17–196: recorded by Gundlach.

Megadytes fraternus Sharp
(as *Cybister laevigatus* Fabr.) Stahl. Gundlach.
Leng & Mutchler 17–196: recorded by Gundlach.
at light at Guánica (1050–13 det. Schwarz), crawling over mud near stream (31–17).

Megadytes giganteus Castelnau
(as *Cybister l'herminieri* Guerin) Stahl. Gundlach.
Leng & Mutchler 17–196: recorded by Gundlach and Van Zwaluwenburg.

GYRINIDÆ.

Dineutes metalicus Aube
Stahl. Gundlach. AMNH.

Dineutes longimanus Olivier
Gundlach.
in stream at Aibonito (577–16 det. Schwarz).

HYDROPHILIDÆ.

Ochthebius sp. nov.—det. Schwarz.
at Santa Isabel, flying in great abundance in early morning (121–13).

Hydrochus pallipes Chevrolat
Gundlach.
(as sp.) Wetmore 16–66: eaten by Tody, *Todus mexicanus.*

Berosus sp.
Wetmore 16–24, 39, 41, 42, 66, 67, 84: eaten by Blue Heron, Sandpipers, Tody and Cliff Swallow.

Hydrophilus (Hydrous) tenebrioides Jacq. Duval
(as *Hydrous*) Stahl. Gundlach.
(as sp.) Wetmore 16–24: eaten by Little Blue Heron.
at light (663–17, 291–22), at Pt. Cangrejos (GNW), at Santana (215–16), at Guánica (1147–13 det. Schwarz).

Stethoxus insularis Castelnau
(as *Hydrophilus*) Stahl. Gundlach.
Leng & Mutchler 17–197

Stethoxus intermedius Jacq. Duval
(as *Hydrophilus*) Stahl. Gundlach.
(as *S. ater* Olivier) Wetmore 16–24: eaten by Little Blue Heron.
(in synonymy with *S. ater* Olivier) Leng & Mutchler.
Leng & Mutchler 17–196: from Culebra Island. According to Mr. F. Wintersteiner "not identical with the Central American species *ater* (Olivier)."
at light (36–10 det. Schwarz), at Aibonito (SSC).

Tropisternus collaris Fabricius
Stahl. Gundlach.
Wetmore 16–22, 87: eaten by Green Heron and Martin.

Tropisternus chalybeus Castelnau
Leng & Mutchler 17–192.
(as sp.) Wetmore 16–63: eaten by Woodpecker.

Tropisternus lateralis Fabricius
Stahl. Gundlach.
(as *T. nimbatus* Say) Wetmore 16–24: eaten by Little Blue Heron.
in pool of water (32–17 det. Schwarz, 711–16).

Philhydrus melanocephalus Fabricius
Gundlach. (as sp.) Wetmore 16–39: eaten by Killdeer.

Philhydrus nebulosus Say
Leng & Mutchler 17–197.

Philhydrus ochracea Melsheimer
Leng & Mutchler 17–197.

Dactylosternum advectum Horn
Leng & Mutchler 17–197.

Dactylosternum flavicorne Mulsant
(as *Cyclonotum*) Stahl. Gundlach.
common under bark of decaying bucare tree, *Erythrina glauca*, at Cayey (302–17 det. as sp. Schwarz).

Oosternum costatum Sharp
Leng & Mutchler 17–197.

Phaenonotum estriatum Say—det. Schwarz
at light (455–16), in stomach of lizzard, *Anolis pulchellus* (297–23); common on cane trash at Arecibo (1069–16).

Cercyon sp.
Wetmore 16–87: eaten by Cliff Swallow.

SCYDMANIDÆ.

Euconnus coralinus Reitter
Leng & Mutchler.

Euconnus testaceous Schaum
Leng & Mutchler.

Napochus tantillus Reitter
Leng & Mutchler.

Napochus amoenus Reitter
Leng & Mutchler.

STAPHYLINIDÆ.

Piestus erythropus Erichson
Stahl.

Lispinus attenuatus Erichson
Leng & Mutchler.

Lispinus laticollis Erichson
Leng & Mutchler.

Ancaeus exiguus Erichson
Leng & Mutchler.

Thoracophorus dentricollis Erichson
Leng & Mutchler.

Ornalium pedicularium Erichson
Leng & Mutchler.

Trogophloeus aridus Jacq. Duval
Gundlach.

Trogophloeus fulvipes Erichson
(as *T. aequalis* Jacq. Duval) Gundlach.
Leng & Mutchler.

Holotrochus cylindricus Erichson
Leng & Mutchler.

Pinophilus flavipes Erichson
Leng & Mutchler.

Pinophilus latipes Gravenhorst
Gundlach.

Stilicopsis exigua Erichson
Leng & Mutchler.

Lithocharis dorsalis Erichson
Leng & Mutchler.

Lithocharis ochracea Gravenhorst
Gundlach.

Lithocharis posticata Erichson
Leng & Mutchler.

Scopaeus fasciatellus Erichson
Leng & Mutchler.

Scopaeus pygmaeus Erichson
Leng & Mutchler.

Cryptobium albipes Erichson
Leng & Mutchler.

Cryptobium fulvipes Erichson
Leng & Mutchler.

Paederomimus lustralis Erichson
Leng & Mutchler.

Philonthus alumnus Erichson
Leng & Mutchler.

Philonthus havaniensis Castelnau
Leng & Mutchler.

Philonthus humilis Erichson
Leng & Mutchler.

Belonuchus gagates Erichson
Leng & Mutchler.

Xantholinus attenuatus Erichson
at Guánica (542–13 det. Schwarz).
Leng & Mutchler. Merrill 15–54: in fresh cow dung.

Cilea hepatica Erichson
Leng & Mutchler.

Cilea rutilus Erichson
Leng & Mutchler.

Cilea pulchellus Erichson
Leng & Mutchler.

Erchomus piceus Erichson
Leng & Mutchler.

Erchomus apicalis Erichson
Leng & Mutchler.

Erchomus nitidulus Erichson
Leng & Mutchler.

Coproporus terminalis Erichson
Leng & Mutchler.

Bolitobius obscurus Erichson
Leng & Mutchler.

Gyrophaena sp.—det. Schwarz.
common on a fungus, *Daedalea amaniloides* (1221-13).

Aleochara sp. nov.—det. Schwarz.
in cow dung at Guánica (GBM).

Hoplandria terminata Erichson
Leng & Mutchler.

PSELAPHIDÆ

Acratrichis atomaria DeGeer
Leng & Mutchler.

Melba eggersi Reitter
Leng & Mutchler.

Melba parmata Reitter
Leng & Mutchler.

Melba ventricola Reitter
Leng & Mutchler.

PTILIIDÆ.

Reichenbachia encera Aube
Leng & Mutchler.

HISTERIDÆ.

Lioderma interrupta Marseul
(as *L. ruptistria* Marseul) Gundlach.
Leng & Mutchler 17-203: recorded by Gundlach.

Lioderma 4-dentatum Fabricius—det. Schwarz.
under bark of decaying bucare tree, *Erythrina glauca*, at Cayey (245-17).

Hister sp.
Wetmore 16–100: eaten by Waterthrush.

Omalodes kugii Marseul
Gundlach.

Omalodes ruficlavis Sharp—det. Schwarz
under bark of decaying bucare tree, *Erythrina glauca*, at Cayey (246–17, 358–22); resting on grapefruit leaf at Manatí (155–15).

Epierus antillarum Marseul
Leng & Mutchler.

Epierus waterhousei Marseul
Leng & Mutchler 17–203.

Atholus confinis Erichson
Leng & Mutchler 17–203.

Carnicops troglodytes Paykull
Gundlach.

Acritus analis Leconte
Gundlach, "muy pequeña (no pasa de 1 mm. en longitud)."
in cow dung at Guánica (544–13 det. Schwarz).

LYCIDÆ.

LITERATURE.

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Mutchler, A. J., "Notes on West Indian Lycidae and Lampyridae (Coleoptera), with Descriptions of New Forms." American Museum Novitates No. 60, pp. 1–13, fig. 1, New York, March 15, 1923.

Mutchler, A. J., "Notes on West Indian Lampyridae and Cantharidae (Coleoptera) with Descriptions of New Forms." American Museum Novitates No. 63, pp. 1–9, fig. 1, New York, March 29, 1923.

Specimens of Lampyridae and Cantharidae determined by Messrs. Leng & Mutchler are noted by "det. L. & M." placed after the accession number or the initials of the collector.

Thonalmus chevrolati Bourgeois
(as *Calopteron suave* J. Duval) Stahl.
(as *Calopteron bicolor* Linn.) Van Z. (P. R. 807).
Leng & Mutchler 22–422: "in Porto Rico, by commercial introduction only, ... at Guánica, April in boat-load of cane from Higueral, (R. H. Zwaluwenburg)."

Leptolycus heterocornis Leng & Mutchler 22–430 and 431, fig. 12. TYPE from Porto Rico: swept from vegetation at Arecibo and Cayey.

Leptolycus heterocornis var. **flavicollis** Leng & Mutchler 22–431. TYPE of variety from Aibonito, Porto Rico.

LAMPYRIDÆ.

Lucidiota decorus Gemminger & Harold
(as *Photinus decorus* E. Olivier) Leng & Mutchler 14–432.
Leng & Mutchler 22–536: redescribed, from Naguabo, Coamo Springs, Corozal Cave and Bayamón.
on coffee leaves (84–21); on grapefruit leaves at Vega Alta (104–17 det. L. & M.); on El Duque at Naguabo (725–14); on leaves of *Solanum torvum* at Barranquitas (404–22).

Lucidiota marginipennis Leng & Mutchler 22–438, TYPE from Aibonito, Porto Rico.

Callopisma borencona Leng & Mutchler 22–440 and 441, figs. 17 & 17a, TYPE from Porto Rico: at Mayagüez, Adjuntas and Martin Peña.
(as *Lychnuris dimidiatipennis* J. Duval) Stahl.
Mutchler 23 (No. 60) –9: from Vega Alta and Lares.
on grapefruit foliage at Vega Alta (103–17 det. L. & M.); on coffee leaves at Lares (131–21 det. L. & M.), at Yauco (108–23).

Callopisma emarginata Leng & Mutchler 22–443, figs. 22 & 22a, TYPE from Porto Rico: at Mayagüez, Adjuntas, Río Blanco Valley and Utuado.

Pyractomena galeata E. Olivier, Bull. Soc. Zool. France, Vol. 24, p. 91, 1899, TYPE from Porto Rico and St. Thomas.
(as *Lecontea*) Leng & Mutchler 14–432.
Leng & Mutchler 22–453: at Fajardo, Arroyo, Aibonito, Manatí, Arecibo, Aguadilla and Santa Rita, and from Vieques Island.
Mutchler 23 (No. 60) –13: from La Plata.
at La Plata (GBM det. L. & M.); at Barceloneta (218–16); resting in cotton boll at Pt. Cangrejos (394–22).

Photinus heterodoxus Leng & Mutchler 22–457 and 459, fig. 29, TYPE from Porto Rico: at Adjuntas and Fajardo.
Mutchler 23 (No. 63) –1: notes.
(unlabeled specimens — det. L. & M.).

Photinus dubiosus Leng & Mutchler 22–461, fig. 30, TYPE from Porto Rico: at Adjuntas, Mayagüez, Añasco, Maricao, Arecibo, Manatí, Aibonito, Caguas and Arroyo.
Mutchler 23 (No. 63) –2: from Lares and Río Piedras.
(as *P. glaucus*) Wetmore 16–106, 114, 116: eaten by Yellow Warbler, Yellow-Shouldered Blackbird and Oriole.
at light at Guánica (187–15) and on weeds (386–21); on coffee leaves (85–21 det. L. & M.), at Lares (107–22 det. L. & M.), at Ciales (57–21), in mountains north of Yauco (307–21), at San Sebastián (100–21); on *Solanum torvum* at Barranquitas (405–22); at Aibonito (SSC); on cotton at Boquerón (34–23).

Photinus triangularis E. Olivier, Ann. Soc. Ent. Belgique, Vol. 56, p. 25, 1912; Rev. Sci. du Bourbonnais, Vol. 25, p. 33, TYPE from El Yunque, Porto Rico.
Leng & Mutchler 14–432.
Leng & Mutchler 22–462, fig. 31: from Culebra Island.

Photinus vittatus G. A. Olivier, "Entomologie" II, No. 28, p. 23, pl. 3, fig. 20, 1790, TYPE from Porto Rico and Santo Domingo.
Wetmore 16–87, 106, 108: eaten by Cliff Swallow and Warblers.
(as sp.) Wetmore 16–80, 96, 108: eaten by Petchary, Vireo and Parula Warbler.
Leng & Mutchler 22–478: short description, from many localities.
Mutchler 23 (No. 63) –7: from Guánica, Toa Alta and La Plata.
at light at Guánica (578–13), at La Plata (GBM — det. L. & M.); on sugar cane (GNW) at Guánica and Toa Alta (GNW — det. L. & M.); on coffee at Añasco (1371–12); on grapefruit at Vega Baja (513–16).

CANTHARIDÆ (TELEPHORIDÆ).

Tytthonyx cavicornis Leng & Mutchler 22–489, fig. 55, TYPE from Mona Island.

Tytthonyx discolor Leng & Mutchler 22–490, figs. 54 & 54a, TYPE from Aibonito, Porto Rico: also from Desecheo Island.
Mutchler 23 (No. 63) –9: from Lares.
(one specimen from Lares or Camuy, det. L. & M.)

Tylocerus barberi Leng & Mutchler 22–497, fig. 65, TYPE from Manatí, Porto Rico: from many localities, "most of the specimens collected at light."

on corn (535–12 paraTYPE); at light at Guánica (578–13 paraTYPE), at La Plata (GBM, July 11, 1915); at Cayey (27–21); on water-sprout of undetermined tree in large numbers, at Barceloneta (217–16); resting on grapefruit foliage at Vega Baja (514–16).

MELRRIDÆ

Alymeris sp.—det. G. E. Bryant
on cotton boll at Pt. Cangrejos (399–22).

CLERIDÆ.

Opilo unifasciatus Erichson
Gundlach, determined by M. Chevrolat.

Callotillus crusoe Wolcott, A. B., "Two New Species of West Indian Cleridae." American Museum Novitates, No. 59, Feb. 14, 1923, pp. 1–3, fig. 1, TYPE from Camuy, Porto Rico.
on ground at Camuy (204–22 TYPE).

OEDEMERIDÆ.

Oxacis geniculata Chevrolat 77–X, TYPE from Porto Rico.
Stahl. Gundlach. Leng & Mutchler.
common on the beach in the spring, at Loíza (130–16) attracted by fire, and on flowers of *Metastelma* sp., on leaves of *Coccoloba uvifera* (257–16); attracted by light in Condado (130a–16), at Plantaje and Palo Seco (229–16), at Pt. Cangrejos (GNW). Larger specimens have a pinkish irridescence, smaller ones are greenish.

Ananca vittata Fabricius
Chevrolat 77–X. Gundlach. Leng & Mutchler
Leng & Mutchler 17–215: from Vieques Island.
common at light near beach (277–12), at Santurce (141–22), at Pt. Cangrejos (January to March, GNW), at Aguirre (160– May 3, 1916), at Guánica (568– July and August 1913).

MORDELLIDÆ

Mordella basifulva Quedenfeldt, G., 86–125, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.
(as sp.) on *Casearia* flowers at Trujillo Alto (887–13 det. Schwarz).

Mordella leucocephala Quedenfeldt, G., 86–124, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.

Mordella scutellaris Fabricius
Quedenfeldt. Gundlach. Leng & Mutchler.

Moredellistena signaticollis Quedenfeldt, G., (as *Mordella*) 86–125, TYPE from Porto Rico.
(as *Mordella*) Gundlach.
Leng & Mutchler.
(as sp.) Wetmore 16–84: eaten by Wood Pewee.

Mordellistena annuliventris Quedenfeldt, G., 86–126, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.
(as sp.) Wetmore 16–99, 106: eaten by Redstart and Yellow Warbler.

Mordellistena ferruginea Fabricius
Quedenfeldt. Gundlach. Leng & Mutchler.

RHIPIPHORIDÆ.

Macrosiagon basalis Gerstaecker
(as *Rhipiphorus*) Quedenfeldt 86–128. Gundlach.
Leng & Mutchler.

Macrosiagon discicolle mutilatus Gerstaecker
(as *Rhipiphorus*) Quedenfeldt 86–128. Gundlach.
Leng & Mutchler.

Macrosiagon discicolle melanoptera Chevrolat, A., (as *Emenadia*) 87–IX, TYPE from Porto Rico.
Gundlach, "M. Chevrolat nombre una variedad *Emenadia melanoptera* en 1887 en la Rev. Zool."
Leng & Mutchler.

Macrosiagon discicolle quadrimaculatus Gerstaecker
(as *Rhipiphorus*) Quedenfeldt 86–128. Gundlach.
Leng & Mutchler.

Rhipiphorus sordidum Gerstaecker. var. **major** Quedenfeldt, G., 86–128, TYPE of variety from Porto Rico.
Gundlach. Leng & Mutchler.
(as sp.) Wetmore 16–89: eaten by Martin.

MELOIDÆ.

Epicauta annulicornis Chevrolat, A., 77–IX, TYPE from Porto Rico.
Gundlach.
(as *Cantharsis*) Leng & Mutchler.
(as *Macrobasis*) Van Z. (P. R. 803).

Epicauta obscuricornis Chevrolat, A., 77–IX, TYPE from Porto Rico.
Gundlach.
(as *Cantharsis*) Leng & Mutchler.

Zonitis sp.—det. Schwarz
Mostly dull yellow in color, median area of disc of prothotrax and two large longitudinal bands on each elytra brown; length 11 mm.
at light at Guánica (590–13)

Zonitis sp.—det. Schwarz
15–16 mm. long: areas of brown at base and near apex of elytra.
at light at Guánica (613–13).

Horia auriculata Duges—det. Schwarz
(a single unlabeled female.)

Tetraonyx quadrimaculatus Fabricius
Chevrolat 77–X. Stahl. Gundlach. Leng & Mutchler.
(209–13 det. Schwarz); on flowers of *Aeschynomena americana* at Arecibo (3–17).

ANTHICIDÆ.

Anthicus florialis Paykull
Stahl. Quedenfeldt. Gundlach. Leng & Mutchler.
Wetmore 16–114: eaten by Yellow-Shouldered Blackbird.
abundant in central whorl of young shoots of sugar cane at Arecibo (636–21).

Anthicus vicinus LeFerté—Sénectére, M. F. T. de, "Monographie des *Anthicus* et. gen. voisins" Paris, 1848, p. 157, TYPE, given as "America borealis," from Porto Rico.
(and as *A. fulvomicans* Quedenfeldt, G. 86–122, TYPE from Porto Rico) Gundlach. Leng & Mutchler.
Merrill 15–54: in fresh cow dung.
in cow dung at Guánica (GBM — det. Schwarz), (and probably this species: ferrugineous, shining, not pubescent, legs lighter in color, elytra densely punctate, dark at apex and about the middle) under old cow manure at Guánica (543–13).

Anthicus sp. poss. **fulvipes** LaFerté—det. Schwarz
among aphids under okra leaves (733–13).

Notoxus bipunctatus Chevrolat, A., Ann. Soc. Ent. France (5), VII, Bulletin p. ix, 1877, TYPE from Porto Rico.
Leng & Mutchler.
at light at Pt. Cangrejos (GNW, Dec. 1919,—Feb. 1920, det. Schwarz).

Notoxus dentipennis Chevrolat, A., Bull. Soc. Ent. France, (5), VII, Bulletin p. ix, December, 1877, TYPE from Porto Rico.
(as *N. krugii* Quedenfeldt, G., 86–121, TYPE from Porto Rico.)
Gundlach.

ELATERIDÆ.

Mr. R. H. Van Zwaluwenburg, at the time he was in the United States Bureau of Entomology, determined all the species of Elateridae here listed.

Pyrophorus luminosus Illiger, J. C. W., "Monogr. d. Elateren (*Pyrophorus*)" Mag. Gesellschaft nat. Fr. 1, p. 149, 1807, TYPE from Porto Rico.
(as *Elater phosphoreus*) Ledru 1780.
(as *P. pyralis* Germar or *P. phosphoreus*) Fabr.) Stahl.
Gundlach. Leng & Mutchler. Van Z. (P. R. 23) adults in decaying fallen mangoes, larvae predatory of white grubs.
Wolcott, G. N., "El Cucubano, *Pyrophorus luminosus* Ill." Circular 80, Insular Experiment Station, Río Piedras, Oct. 1923. pp. 5–8, figs. 3.
in April (75–11, 253–12, 295–12 at Pueblo Viejo, 313–12, 392–13, 107–21), in February (71–23); at Toa Baja in April (93–15); at Hormigueros in March (THJ); at Aibonito in July (SSC); at Yauco in July (765–15).

Monocrepidus bifoveatus Palisot de Beauvois
Wetmore 16–61, 96, 114, 119: eaten by Ani, Latimer's Vireo, Yellow-Shouldered Blackbird and Mozambique.
at light (140–April, 1922, 180–July, 1921), at Pt. Cangrejos (April and May, 1920, GNW), one adult at Guánica (705–June, 1914); on grapefruit foliage at Vega Baja (494–August, 1916), at Barceloneta (220–June, 1916); at Pt. Cangrejos on *Corchorus hirsutus* (81–June, 1916); in cotton squares at Isabela (167–June, 1921), at Hatillo (298–October, 1922); in empty cocoons of *Alabama argillacea* Hübner at Hatillo (202-August, 1922).

Monocrepidus lividus DeGeer
(as sp.) Wetmore 16–84, 106: eaten by Wood Pewee and Yellow Warbler.
at light at Pt. Cangrejos (January to May, 1920, GNW): at Hatillo in cocoons of *Alabama argillacea* Hübner (202-August, 1922).

Monocrepidus pinguis Candeze
at light (74–April, 1911, at Aibonito (June 1, 1913, SSC).

Monocrepidus memorabilis Candeze
at light at Guánica (506½–13).

Heteroderes amphicollis Gyllenhal (?)
in earth (243–12).

Aeolus binotatus Candeze (?)
under cane trash at Arecibo (189–11).

Aeolus elegans Fabricius
Gundlach.
(as *Drasterius* sp.) Wetmore 16–22: eaten by Cuban Green Heron.
on leaves of eggplant (735–13, 343–17); on leaves of *Rauwolfia nitida* at Yauco (316–21); on leaves of undetermined plant at Barceloneta (219–16); in excrement of *Laphygma frugiperda* S. & A., on corn at Aguadilla (27–22); in cotton squares at Garrochales (299–22).

Aeolus sp.—det. Schwarz.
only 3 mm. long, elytra densely ciliate and punctate, lighter brown in color than the polished prothorax, with a small elongate dark brown area on the outer margin opposite a large, irregularly-semicircular, piceous spot about the middle of the inner margin, which is dark brown almost to apex.
in pile of coconut husks near beach at Arecibo (250–22).

EUCNEMIDÆ.

Arrhipis lanieri Guerin
Leng & Mutchler.
Microrhagus sp.
Wetmore 16–66: eaten by P. R. Tody, *Todus mexicanus*.

TRIXAYIDÆ.

Drapetes chalybeus Gerstaecker
Leng & Mutchler.

BUPRESTIDÆ.

Mr. W. S. Fisher has examined, and has determined or will describe all specimens of Buprestidae in the Insular Station collection.

Acmaeodera sp. nov.
on mangrove flowers at Martin Peña (524–17; on sugar cane at Guánica (175–22).

Acmaeodera sp. nov.
(as sp.) Wetmore 16–77, 80, 82, 96, 125: eaten by Kingbird, Petchary, Flycatcher, Latimer's Vireo and Grossbeak.
on mangrove flowers at Martin Peña (523–17).

Buprestis lineata Fabricius
(as *Ancylochira*) Stahl. Gundlach.

Buprestis decora Olivier
(as *Ancylochira*) Gundlach.

Chrysobothris denticulata Castelnau & Gory
Wetmore 16–80: eaten by Petchary, *Tolmarchus taylori*.

Chrysobothris tranquebarica Gmelin
(as *C. impressa* Fabr.) Stahl. Gundlach.
Van Z. (P. R. 1668) on *Eucalyptus* sp.
(as sp.) Wetmore 16–84, 119: eaten by Wood Pewee and Mozambique.
on stump at San Sebastián (97–21).

Chrysobothris lepida Castelnau & Gory
Gundlach.

Chrysobothris megacephala Castelnau & Gory
(176–22 — date and locality unknown.)

Chrysobothris sp. nov.
thorax dark red, abdomen blue, elytra black with four transverse irridescent green bands: about 6 mm. long.
(798–12.)

Taphrocerus sp. nov.
on El Yunque at Mameyes (329–17).

HELODIDÆ.

Scirtes sp.—det. Marshall
in cotton squares at Algarroba (198–22).

CHELONARIIDÆ.

Chelonarium punctatum Fabricius
Stahl. Gundlach.
resting on leaf of *Inga vera* at Ciales (219–22); elytra in bird dung at Camuy (GMW): larva in rotten stump at Lares, reared to adult (164–21 det. Schwarz).

DERMESTIDÆ.

Dermestes vulpinus Fabricius
Stahl. Gundlach.

Dermestes carnivorus Fabricius
Stahl. Gundlach.

Cryptorhpalum sp.
Wetmore 16–104, 106, 108: eaten by Warblers.

Trogoderma insulare Chevrolat
Stahl. Gundlach.

Globocornis fulvipes Guerin
(as *Trogoderma*) Stahl. Gundlach.

Attagenus piceus Olivier—det. Schwarz
on cotton at Quebradillas (307–22).

OSTOMIDÆ (TEMNOCHILIDÆ TROGOSITIDÆ).

Temnochila aenea Olivier
Leng & Mutchler.

Temnochila portoricensis Leveille, A., Ann. Soc. Ent. France, Vol. 76, p. 401, 1907, TYPE from Porto Rico.
Leng & Mutchler.
(as sp.) Wetmore 16–63: eaten by Woodpecker.

Tenebroides punctulata Chevrolat
(as *Trogosita*) Stahl.
(as sp.) Wetmore 16–63, 66: eaten by Woodpecker and Tody.
Leng & Mutchler.

Tenebroides transversicollis Jacq. Duval
(as *Trogosita*) Gundlach.

Tenebroides mauritanicus Linn.—det. Cotton
reared from rice (314–22).

NITIDULIDÆ.

Colopterus amputatus Erichson
Leng & Mutchler.

Colopterus truncatus Randall
Leng & Mutchler.

Conotelus fuscipennis Erichson
Stahl. Gundlach, "se le encuentra amenudo en el caliz de las flores."
(as *C. conicus* Fabr.) Leng & Mutchler 17–203.
in flowers of *Partium tiliaceum* at Ciales (280-22 det. Schwarz); in flowers of *Tecoma pentaphylla* (266–12).

Carpophilus dimidiatus Fabricius
Van Z. (P. R. 1514) in corn meal.
in flour (290–17 — det. doubtful).

Carpophilus dimidatus, var. mutilatus Erichson
Leng & Mutchler 17–203: from Vieques Island.

Carpophilus hemipterus Linn.—det. Schwarz
Wetmore 16–89: eaten by Martin.
on decaying cane seed (349–12).

Haptoncus luteolus Erichson
(as *Epurma*) Gundlach
Wetmore 16–74: eaten by Flycatcher, *Anthracothorax aurulentus*.
under leaf-sheaths of sugar cane (202–11 det. Schwarz), very abundant on cane chewed by rats (726–13 det. Schwarz); on tassels of corn growing in cane field at Trujillo Alto (724–12 det. Schwarz).

Stelidota geminata Say
Gundlach.

(as sp.) Wetmore 16–75, 87: eaten by Swift and Cliff Swallow.

Stelidota ruderata Erichson
Gundlach.

Lobiopa decumana Erichson
Stahl. Gundlach.
(as *L. insularis* Castelnau) Leng & Mutchler 17–203: recorded by Gundlach.
all stages in fruit of *Psidium guajava* on the ground (224–16 det. Schwarz).

MONOTOMIDÆ.

Europs apicalis Reitter
Wetmore 16–116, 121: eaten by Oriole and Tanager.
in pods of *Inga laurina* at Lares (111–22 det. Schwarz).

CUCUJIDÆ

Silvanus surinamensis Linn.
Van Z. (1512) in stored grain. Wolcott 22b–6: notes.
in corn (613–17), in rice (625–17), in dry dates (94–21), in almonds (369–22).

Silvanus gemellatus Jacq. Duval
in pods of "aroma", *Acacia farnesiana*, at Boquerón (101–23).

Cathartus advena Waltl
(as *Silvanus*) Gundlach. Riley & Howard, Insect Life, Vol. 6, Feb. 1894, p. 218.

Nausibius clavicornis Kugelann
(as *N. dentatus* Marsham) Stahl. Gundlach.
Wolcott 22b–6: in brown sugar, notes.

Laemophloeus adustus Leconte
Gundlach.

Laemophloeus unicornis Grouvelle
Leng & Mutchler.

Laemophloeus pusillus Schönherr
Leng & Mutchler 17–201.
(as *L. minutes* Oliv.) Wolcott 22b–6: in flour and soup pastes.
in wheat flour (1209–13, 291–17), in macaroni (620–17 det. Cotton), in seeds (651–17).

Telephanus pallidulus Chevrolat
Leng & Mutchler. Wolcott 21–44, fig. 19: larvae and adults under leaf-sheaths of sugar cane and on dry banana leaves, notes.
under leaf-sheaths of sugar cane (391–12, 272–13, 359–13 det. Schwarz), at Camuy, Barceloneta and Córsica (GNW).

CRYPTOPHAGIDÆ.

Loberus testaceus Reitter
Leng & Mutchler 17–202.
(as sp.) Wetmore 16–66, 74: eaten by Tody, *Todus mexicanus*, and Flycatcher, *Anthracothorax aurulentus*.
(det. as sp. near *testaceus* by Mr. G. E. Bryant) in cotton bolls injured by Pink Bollworm at Pt. Cangrejos (400–22); in buds of majagua, *Partium tiliaceum*, at Arecibo (254–22); in pods of *Acacia farnesiana* at Boquerón (103–23).

MYCETOPHAGIDÆ.

Typhaea semirufa Chevrolat
Gundlach.

Litargus sp.
Wetmore 16–108: eaten by Northern Parula Warbler.

COLYDIDÆ.

Euxestus erithacus Chevrolat
Leng & Mutchler. Leng & Mutchler 17–200: "probably not more than a variety of *E. parki* Wollaston."

Synchita granulata Say
(as *Endeitoma*) Wetmore 16–108: eaten by Black & White Warbler.
under bark of *Inga vera* at Cayey (248–22 det. Mutchler, 1–23); under bark of fence post at Boquerón (172–23).

Bitoma trifasciata Moritz
(as *Ditoma*) Leng & Mutchler.

Aulonium bidentatum Fabricius
Gundlach. Leng & Mutchler.
Wetmore 16–108: eaten by Black & White Warbler, *Mniotilla varia*.

Penthelispa acqueicolle Reitter
Leng & Mutchler.

Neotrichus tuberculata Chevrolat
Leng & Mutchler.

Eulachus semifuliginosus Chevrolat
Gundlach. Leng & Mutchler.

Cryptozoon civile Schaufuss
Leng & Mutchler.

Cryptozoon nitidicole Schaufuss
Leng & Mutchler.

Ceryldon exaratum Chevrolat
Leng & Mutchler.

LANTHRIDIIDÆ.

"**Lathridius fasciatus** es su nombre en la collección del Museo de Berlín."
Gundlach.

PHALACRIDÆ.

Olibrus sp.
Wetmore 16–108: eaten by Northern Parula Warbler.

COCCINELLIDÆ.

LITERATURE.

Sicard, "Descriptions de Varietes, Especes et Generes nouveaux appartenant a la Famille des Coccinellides." Ann. & Mag. Nat. Hist., Ser. 9, Vol 9, pp. 349–360, April, 1922.

Hyperaspis apicalis Mulsant (in Weise)
Gundlach. Leng & Mutchler. (as sp.) Jones 15b–13: notes.
Wetmore 16–89, 108, 119: eaten by Martin, Parula Warbler and Mozambique.
Wolcott 21–45: common in cane fields, predaceous on *Sipha flava* Forbes. Wolcott 22–6: notes.
on weeds in cane field (1–13, 75–13); feeding on aphids on okra (727–13 det. Schwarz); on sugar cane on which mealy-bugs were exposed by the leaf-sheath having been chewed away at Fajardo (909A–14) · on flower spikes of *Heliotropum indicum* (191–16); feeding on *Aphis gossypii* Glover on cotton at Isabela (200–21); on sugar cane at Bayamón, Toa Baja, Caguas, Guánica and Patillas (GNW)

Hyperaspis connectens Thunberg (in Schönherr)
Gundlach. Leng & Mutchler.
on sugar cane at Guánica (517–13), at Aguirre (72–163), at Barceloneta, Córsica and Patillas (GNW — det. Schwarz); feeding on *Aphis gossypii* Glover on cotton at Isabela, more abundant than *H. apicalis* (199–21)

Scymnus loewii Mulsant
Leng & Mutchler.
Van Dine 13–257; Van Dine 13–32; Jones 15b–13; Wolcott 21–45: feeding on *Sipha flava* Forbes on sugar cane
Wolcott 22–6: notes.
feeding on *Sipha flava* Forbes on sugar cane at Guánica (167–11, 168–11 det. Schwarz); feeding on *Aphis gossypii* Glover on cotton at Guánica (120–13), at Isabela (201–21), on sugar cane at Patillas and Guánica (GNW).

Scymnus florialis Fabricius
Gundlach.

Scymnus phaleus Mulsant
Gundlach.

Scymnus roseicollis Mulsant
(as *S. thoracicus* Fabricius) Gundlach. (and also as *S. ochroderus* Mulsant) Leng & Mutchler.

Wetmore 16–66, 84, 96, 99, 108, 111: eaten by Tody, Wood Pewee, Vireo, Redstart, Yellow and Parula Warblers, and Honey Creeper.

Van Dine 13–257; Van Dine 13–32; Jones 15b–13; Jones 14–462; Wolcott 21–45: predaceous on *Sipha flava* Forbes on sugar cane.

Jones 15b–17: predaceous on *Aphis setariae* Thos. on sugar cane.

Wolcott 22–6: notes and illustrations of larva, pupa and adult.

feeding on *Sipha flava* Forbes on sugar cane (439–12, 607–12, 691–12), at Guánica (167–11, 168–11 det. Schwarz); on *Aphis setariae* Thos. on sugar cane (946–13); on *Aphis gossypii* Glover on cucumbers (421–12), on cotton (443–21), at Isabela (201–21); on aphids on okra (574–12, 728–13).

Cryptolaemus montrouzieri Mulsant

Van Dine 12–20: "introduced by this Station from California last season, has been distributed throughout all of the cane districts and has been recovered already from the field."

Van Dine 13–256; Van Dine 13–30: an enemy of *Pseudococcus sacchari* Ckll.

Leng & Mutchler 14–411: "(introduced)."

Wolcott 22d–17: the introduction from California, distribution in cane fields in Porto Rico to feed on mealy-bugs on sugar cane and subsequent recovery feeding on other mealy-bugs, and on fleshy scale-insects, but not on *Pseudococcus calceolariae* Maskell and *P. sacchari* Ckll., which are protected by the leaf-sheaths of the sugar cane.

feeding on *Pseudococcus citri* Risso on bucare trees, *Erythrina glauca* (42–21); feeding on *Pulvinaria psidii* Maskell on *Rauwolfia nitida* at Guánica (317–21); on aphis-infested cotton at Guánica (105–13).

Psorolyma maxillosa Sicard 22–360, TYPE from Lares, Porto Rico: "Ovalis, convexa nitida, coerulea; subtus piceo-brunnea; antennis, palpis, pedibusque pallide flavis. Mandibulis exsertis, oculis prominentibus distinctissimus. — Long 2.5 mm."

Wolcott 23–57: on coffee.

on coffee leaves at Lares (98–21 TYPE, 132–21, 294–21, 473–21, 294–22), also at San Sebastián, Corozal, Ciales, and most abundantly in the mountains north of Yauco, in September. The larva is grey with black spots, and often two or three occur on a single leaf, without apparent source of animal food, seldom found on young leaves infested with *Toxoptera aurantiae* Boyer.

Scymnillus nunenmacheri Sicard 22–355, TYPE from Río Piedras, Porto Rico: "Subrotundatus, convexus, nitidus; supra nigro-

piceous, thoracis lateribus luteis; subtus brunneo-piceous, antennis, palpis pedibusque rufo-flavis. —Long 1.2–1.5 mm."
abundant on citrus trees at Vega Alta (217–17); feeding on *Chrysomphalus dictyospermi* Morgan on *Cycas revoluta* (171–17), at Naguabo (335–17); feeding on *Aspidiotus destructor* Sign. on coconut palm (352–21 TYPE).

Scymnillus variipennis Sicard 22–354, TYPE from Río Piedras, Porto Rico: "Breviter ovatus, convexus, nitidus; supra rufus, elitris basi nigricantibus, subtus rufescens; antennis, palpis pedibusque flavis. Oculis nigris. —Long 1.5 mm."
(as sp.) Wetmore 16–66, 84, 98, 104, 108, 111: eaten by Tody, Wood Pewee, Vireo and Warblers, and Honey Creeper.
bluish-grey larvae, reddish-brown puparia and adults abundant on leaves of coconut palm infested with *Aspidiotus destructor* Sign. (350–21 TYPE), at Ponce (947–13); on leaves of *Psidium guajava* infested with whitefly, *Aleurodicus minima* Quaint., and mealybugs, *Pseudococcus nipae* Mask. (217–13, 274–13); on leaves of *Spondias jobo* infested with thrips, *Heliothrips rubrocincta* Giard (783–16); feeding on *Pseudococcus citri* Risso on grapefruit (235–17).

Scymnillodes cyanescens Sicard var. **violaceus** Sicard 22–358, TYPE variety from Río Piedras, Porto Rico: "Subrotundus, convexus, nitidus, supra cyaneus; antennis flavis, palpis rufis; subtus nigro brunneus; pedibus rufis. Long 1.5 mm. --- var. *violaceus* nov., Elytris violaceo-micantibus. Prothorace angustiore."
feeding on *Aspidiotus destructor* Sign. on coconut palm (353-21 TYPE); feeding on *Asterolecanium bambusae* Bdv. at Vega Alta (41–17, 218–17).

Psyllobora nana Mulsant
feeding on red spider on beans (204–16, 428–16); on cotton at Isabela (203–21), at Quebradillas (306–22), at Guánica (38–22); on sugar cane at Martin Peña and Seboruco (Pt. Cangrejos) (GNW—det. Schwarz).

Psyllobora lineolata Fabricius
Gundlach.
presumably this species: elytra mostly yellow with several small black spots, on Isle of the Caves, Laguna de San José, Pt. Cangrejos (96–15); on cotton at Boquerón (92–23).

Megilla innotata Mulsant
Stahl. Gundlach. Leng & Mutchler.
Van Z. (5058) predaceous on *Sipha flava* Forbes.
Wolcott 22–6: notes.
Van Dine 13–257; Van Dine 13–32; Jones 15b–12; Wolcott 21–45: predaceous on ***Sipha flava* Forbes.**
on sugar cane (207–11, 30–12, 223–13), at Naguabo (33–10

det. Schwarz), at Humacao (56–10); feeding on *Sipha flava* Forbes on sugar cane (614–12), on aphids on okra (729–13), on aphids on beans (444–16); abundant on flowers of *Verbestina, Mitracarpus* and other weeds, apparently feeding on pollen (500–16).

Hippodamia convergens Guerin (introduced)
Van Z. (5050) predaceous on *Aphis* spp.

Cycloneda sanguinea Linnaeus
(as *Daulis*) Stahl. (as *Neda*) Gundlach.
Leng & Mutchler. Van Z. (5093) predaceous on *Aphis* spp.
(as *C. limbifer*) Wetmore 16–61, 66, 77, 80, 84, 87, 98: eaten by Ani, Tody, Petchary, Wood Pewee, Elainea, Cliff Swallow and Vireo.
Van Dine 13–257; Van Dine 13–32; Jones 15b–12; Wolcott 21–45: predaceous on *Sipha flava* Forbes. Wolcott 22–6: notes
on leaves of sugar cane infested with *Sipha flava* Forbes (13–12, 347–12 det. Schwarz), at Guánica (233–11), at Guayama (170–12, at Añasco (370–12), at Canovanas (717–12), at Trujillo Alto (723–12), at Toa Baja (143–13); reared on these aphids, yellow-spotted black larvae hatching from a small cluster of bright yellow eggs on April 20 & 21, pupating April 30 to May 2, adults issuing May 5 & 6 (417–12, 617–12, 665–12); at Aibonito (SSC), on dry hill north of Ponce (117-13); larvae and adults observed feeding on *Cerataphis lantaniae* Bdvl. on palm (43–21); on *Carolinaia cyperi* Ainslie on sedge, *Cyperus rotundus*, at Bayamón (55–21); on *Aphis gossypii* Glover on cotton at Isabela (198–21); on aphids on okra (730–13).

Daulis ferruginea Olivier
(as *Neda*) Gundlach. Leng & Mutchler.
Wolcott 23–57: on coffee.
larvae, pupae and adults quite abundant at Adjuntas, top of the pass to Ponce, on coffee leaves, although no aphids were present (485–21 det. Schwarz), in mountains north of Yauco (113–22), at Aibonito (693A–17); on *Inga laurina* infested with Psyllids, probably *Psylla minuticona* Crawford, at Lares (146–22).

Exochomus sp.—det. G. E. Bryant
(as *Coccinella* sp. (?)) Wetmore 16–80: eaten by Petchary.
eaten by lizzard, *Anolis cristatellus*, at Condado (302–23); on coconut fronds at Pt. Cangrejos (302–23), on the beach at Mameyes (343–22).

ALLECULIDÆ (CISTELIDÆ).

Allecula flavipes Jacq. Duval
Leng & Mutchler. (in synonymy with *A. fuscula*) Gundlach.

Allecula fuscula Schönherr
Quedenfeldt 86–119. Gundlach. Leng & Mutchler.

Cistela sobrina Dejean
Stahl.

Cteniacantha marginata Quedenfeldt, G., 86–121, TYPE from Porto Rico.
Gundlach. Leng & Mutchler 14–465: under Melandryidae.

Hymenorus sp.—det. Schwarz (possibly *fuscula* Schönherr—det. Mr. K. G. Blair)
very abundant on *Corchorus hirsutus* at Pt. Cangrejos (80–16), in dry sea-weed and under dead vegetation and at light (GNW); at light in Condado (183–16), at Pt. Salinas (292–22); in cotton squares and in empty pupa skins of ***Alabama argillacea*** Hübner close to the beach at Hatillo (203–22, 304–22).

TENEBRIONIDÆ.

Diastolinus fuscicornis Chevrolat, A. A. M., Ann. Soc. Ent. France, (5), VII, Bulletin p. viii, 1877, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.

Sellio probably **tibidens** Quedenfeldt—det. Mr. K. G. Blair
under cow dung at Boquerón (171 23), at Salinas (282–23).

Hopatrinus pullus Sahlberg (= **anthracinus** Mulsant)—det. Schwarz
from base of decaying pineapple slip (705–12).

Blapstinus sp.—det. Schwarz (possibly **punctatus** Fabr.—det .K. G. Blair)
very abundant in soil in cane field at Guánica (654–14); under dry cow dung at Boquerón (93–23).

Trachyscelis (?) flavipes Melseimer—det. K. G. Blair
on the beach at Pt. Cangrejos (108–23).

Phaleria angustata Chevrolat—det. Schwarz
in seaweed on the beach at Pt. Cangrejos (GNW, 109–23), at Pt. Salinas (293–22).

Phaleria variabilis Quedenfeldt, G., 86–128, TYPE from Porto Rico.
Gundlach, "esta especie varía mucho en su colorido que puede ser totalmente el pálido amarillo hasta casi el solo negro o amarillo con una mancha común oscura en forma de luna sobre el disco de los elitros."
P. angustata shows the same variation in color.

Crypticus sp. possibly **obsoletus** Say—det. Schwarz.
Wetmore 16–39: eaten by Killdeer.
in seaweed on the beach at Pt. Cangrejos (GNW).

Rhipidandrus micrographus Lacordaire—det. Schwarz
larvae and adults abundant in polypore fungus, *Fomes australis,* at Jajome Alto (373–21), at Adjuntas (482–21).

(**Eledona pectinicornis**
Gundlach, "en el Museo de Berlín, acaso manuscrito.")

Diaperis hydni Fabricius
Stahl. Gundlach.
(as *D. maculata* Olivier) Leng & Mutchler 17–214.
all stages abundant in polypore fungus (355–12 det. Schwarz, 109–15), in fungus on palm (206–11).

Palembus ocularis Casey—det. Schwarz
all stages in tamarind pods, feeding on seeds, at Loíza (344–21).

Platydema apicale Castelnau & Brulle
Gundlach.

Platydema excavatum Say—det. G. E. Bryant
under bark of dead tree at Vega Baja (113–16).

Platydema picicorne Fabricius
Gundlach.
(as sp.) Wetmore 16–63, 116, 128: eaten by Woodpecker, Oriole and Grasshopper Sparrow.

Platydema virens Castelnau & Brulle
Wetmore 16–108: eaten by Black & White Warbler.

Tribolium ferrugineum Fabricius
Wolcott 22b–6: in flour. (as *Margus*) Gundlach.
in bran (35–12), in wheat flour (1208–13 det. Schwarz, 141–16, 7–21), in dry dates, (95–21); at Aibonito (SSC); in cotton-seed meal stored in tobacco warehouse at Cayey (371–22); in dry tamarind pods at Guánica (544–14).

Tribolium confusum Jacq. Duval
Leng & Mutchler 17–214: recorded by Van Zwaluwenburg.
in cotton-seed meal stored in tobacco warehouse at Cayey (372–22).

Alphitobius piceus Olivier
(as *Heterophaga fagi* Panzer) Gundlach, "encontrado en almacenes y en lugares donde existen substancias descompuestas, secas." Also, with *Tenebrio mauritanicus* Fabr. in synonymy.
Leng & Mutchler 17–214: recorded by Gundlach.

Sitophagus hololeptoides Castelnau
Leng & Mutchler.
(as *Adelina livida* Chevrolat) Gundlach, "Acaso el nombre es manuscrito." Also (as *Hypogena*) Gundlach.

Doliema pallida Say—det. K. G. Blair
under bark of fence post at Boquerón (187–23).

Alphitobius diaperinus Panzer—det. Cotton
in wheat flour (9–21).

Hypophloeus rufipes Fabricius—det. Schwarz
under bark of decaying bucare tree, *Erythrina glauça,* at Cayey (301–17, 359–22).

Helops sp.
Wetmore 16–63, 82, 96, 98, 108, 116: eaten by Woodpecker, Flycatcher, Wood Pewee, Vieroes, Warblers and Oriole.

Zophobas rugipes Kirsch
Leng & Mutchler. AMNH at Corozal Cave.
(10–11, 55–11, 444–19), under boards in barn (122–15), at Bayamón (342–16), at Caguas and Aibonito (SSC).

Zophobas morio Fabricius
Stahl. Gundlach, "se encuentra en las casas debajo de tablas, cajones, etc. Nunca lo he visto en el campo."
Van Z. (P. R. 25).
Leng & Mutchler 17–214: on Culebra Island.

Pyanisia tristis Castelnau
(as *Cymatothes*) Stahl. Gundlach.

Strongylium pulvinatum Maeklin
Leng & Mutchler.
(as sp.) Wetmore 16–96: eaten by Latimer's Vireo.

MONOMMIDÆ.

Hyporhagus marginatus Fabricius
(as *Monomma*) Stahl. Gundlach.

MELANDRYIDÆ.

Cteniacantha marginata Quedenfeldt, G., 86–121, TYPE from Porto Rico.
Gundlach 94–629: under Cistelidae.
Leng & Mutchler 14–465.

PTINIDÆ.

Atractocerus brasiliensis Laporte & Serville
Gundlach, "Solamente la he cogido cuando voló a la vela encendida en las casas de campo. Su vuelo es ruidoso o acompañado de un zumbido."
Leng & Mutchler.

Ptinus sp.
Wetmore 16–108: eaten by Northern Parula Warbler.

ANOBIIDÆ.

Lasioderma serricorne Fabricius—det. Van Dine
Tower 10–26: "a beetle borer in tobacco warehouses, doing a great deal of damage to the stored leaf." Control by fumigation with cyanide.
in books (44–12), in flour (1210–13), eating the string on which camandula, *Coix lachryma,* beads were strung (105–16); at Aibonito (SSC); in cotton-seed meal stored in tobacco warehouse at Cayey (373–22); in stored tobacco at Cayey (374–22).

Catorama sp.
Wetmore 16–66, 72, 74: eaten by Tody and Hummingbirds.

Dorcatoma bibliothecarum Poey
Gundlach, "sumamente dañino, porque su larva perfora libros y destruye colecciones de historia natural, tanto zoológicas como botánicas."
(as *Calymmanderus*) Leng & Mutchler 17–206: recorded by Gundlach.

BOSTRYCHIDÆ.

Dinoderus minutus Fabricius—det. Schwarz
in dry bamboo (120–11); very abundant in flour (140–16); in dead stem of ganduli, *Cajanus cajan,* at Rincón (110–15); in upright dead tree at Vega Alta (170–15).

Rhizopertha pusilla Fabricius
Leng & Mutchler 17–207: "Cosmopolitan species or introduced from the United States in timber."

Apate francisca Fabricius
(as *Apate carmelita* Fabr.) Stahl. Gundlach, "Es dañino a los árboles, perforando la larva, los troncos y ramas."
(as *Apate monachus* Fabr.) Van Z. (24), a borer in branches of pomelo, citron, *Cajanus cajan,* chinaberry, *Linociera domingensis, Salix humboltiana* and coffee.
Van Zwaluwenburg 16–44: "very numerous about Mayagüez and during the past year (1915) has been repeatedly found boring in young mahogany trees. The young stages have been found only in dead trees, but the work of the adults so weakens the trees that they are easily broken in a heavy wind."
Van Zwaluwenburg 17–516: "A living coffee tree may have as many as thirteen adults working in its trunk, and still survive, unless broken over by wind." Additional hosts: grapefruit and dry posts of "palo de hueso", *Picramnia pentandra.*
Smyth 19–139: "rarely riddles the standing stalks" of sugar cane.
Wolcott, G. N., "El Caculo Taladrador del Tallo del Cafeto", Circular 48, Insular Experiment Station, Río Piedras, P. R., October, 1921, pp. 2, fig. 2.

at light (256–13), at Guánica (688–13); boring in small tree of flamboyan, *Poinciana regia* (244–12 det. Schwarz); boring in coffee trees at Sabana Grande (323–21); boring in stalk of sugar cane at Limón, (H. Bourne, collector) 30 adults in one stalk (Photographs Nos. 497 & 500).

Tetrapriocera tridens Fabricius
Leng & Mutchler.
(as *Xylopertha longicornis* Oliv.) Gundlach.
at light at Guánica, July to October, most abundant in early October (589–13 det. Schwarz).

Heterarthron gonager Fabricius
Leng & Mutchler 14–453: from Mona Island.
from algarroba, *Prosopis juliflora,* at Guánica (548–13, 689–13 det. Fischer).

Zylomeira torquata Fabricius
(as *Xylomeira*) Leng & Mutchler.
larvae abundant in dead branch of leguminous tree at Coamo (133–23 det. Fisher).

LYCTIDÆ.

Lyctoxolon japonicum Reitter—det. Schwarz
at light in great numbers, breeding in native clothes basket (17–21), parasitized by Pteromalid wasps, probably *Neocatolaccus* sp. det. Rohwer; in branch of leguminous tree at Coamo (134–23).

CISIDÆ.

Ennearthron delicatulum Jacq. Duval
Gundlach.

SCARABÆIDÆ.

Aphodius granarius Linnaeus
Merrill 15–54: in fresh cow manure.
Leng & Mutchler 17–208: "var. undescribed."
in fresh cow manure at Guánica (540–13).

Aphodius lividus Olivier
Merrill 15–54: in fresh cow dung.
Wetmore 16–61: eaten by Ani.
in filter-press cake or cachaza (40–12); in cow dung at Guánica (470–13, 538–13).

Ataenius gracilis Melsheimer
Leng & Mutchler.
Wetmore 16–22, 66: eaten by Green Heron and Tody.

Ataenius imbricatus Melsheimer
Leng & Mutchler 17–208.

Ataenius marginatus Fabricius—det. Schwarz
at light at Pt. Cangrejos (April, 1920, GNW); in cow dung at Arecibo (311–22), at Guánica (471–13).

Ataenius rhyticephalus Chevrolat
(as *Auperia*) Gundlach.

Ataenius stercorator Fabricius
(as *Auperia*) Gundlach.
Merrill 15–54: in fresh cow manure.
Leng & Mutchler 17–208.
Wetmore 16–39, 61, 69, 91, 98: eaten by Killdeer, Ani, Owl, Mockingbird and Vireo.
Wolcott 22d–18: "during the periods of least rainfall on the south side the beetles *Aphodius lividus* Oliv. and *Ataenius stercorator* Fabr. become very abundant and by feeding on and tunneling through the fresh manure change it to a dusty, felty mass of undigested fibers."
in decaying cane seed (751–14), at Loíza (25–11), at Fajardo (231–12), at Aguirre around roots of cane growing in "poyal" land (590–12 det. Schwarz); in old straw (36–12), in filter-press cake or cachaza (39–12, 3–21); under bark of rotten tree at Bayamón (511–17); in cow dung (602–12), at Arecibo (310–22), at Guánica (539–13, 472–13, 555–13); at light at Pt. Cangrejos (GNW), at Guánica (611–13).

Ataenius terminalis Chevrolat
Leng & Mutchler.
(as sp.) Wetmore 16–63, 66: eaten by Woodpecker and Tody.

Psammobius gracilis Jacq. Duval
(as *Psammodius*) Stahl. Gundlach, "Viene por las noches a las velas de las casas."

Trox suberosus Fabricius
(as *T. crenatus* Oliv.) Stahl. Gundlach.
attacking sugar cane, according to Mr. C. T. Murphy, at Guánica (398–12 det. Schwarz as *Trox punctatus* Germar); under dead rat (802–14); at light at Pt. Cangrejos (GNW), at Humacao (57–13), at Guánica (573–13).

Phyllophaga (Lachnosterna) vandinei Smyth, E. G., 17–68; TYPE from Guánica, Porto Rico: "Its habitat is restricted to the western end (of the Island of Porto Rico), its farthest east recorded occurrence being at Manatí on the north coast and at Peñuelas on the south." Larvae feed on roots of plants, especially sugar cane, adults on leaves of sugar cane and many trees (see Smyth 17–79). Length of egg stage 14 days, 1st. instar larva 36 days, 2nd. instar larva 47 days, 3rd. instar larva 183 days, pupa 21 days; total life-cycle approximately

one year, but with two periods of maximum abundance of adults, late April and late August (at Guánica), and a very few present from September to March.

Cotton, R. T. "Experimental Work on the Control of the White Grubs of Porto Rico." Jour. Dept. Agr. P. R., Vol. 2, No. 1, pp. 1–18, January 1918: unsuccessful attempts at control.

Cotton, R. T. "Medios para Combatir los Gusanos Blancos." Circ. No. 12, Insular Experiment Station, Río Piedras, pp. 3–7, 1918, fig. 1 and 2: the practical methods of control.

Redescribed by J. D. More. Oblong, convex, broader behind, pale chestnut on elytra to dark reddish-brown on head, smooth and faintly shining in both sexes but not polished. Length 17 to 22 mm. Head rather coarsely and densely punctate except at base. Clypeus feebly emarginate, margin narrowly reflexed. Thorax less densely punctate with faint median flattening, distinctly narrower in front, sides obtusely angulate; widest a little to the rear of the middle, narrowed slightly towards base, more obliquely narrowed in front, lateral margins irregular, scarcely crenate, sparsely ciliate, posterior margin distinctly impressed on both sides. Elytral punctures somewhat finer than those of thorax, sutural costa well marked, with few sparse punctures and outer margin punctured, discal costa very feeble. Metasternum densely punctured and hair rather sparse. The posterior ventral margin of the fifth abdominal segment has a concavity or furrow with anteriorly a ridge sometimes faintly emarginate in middle Pygidium shining, convex, lightly and sparsely punctate, posterior margin sharply reflexed and with a single row of long hairs. Antennae nine jointed. Last joint maxillary palpus elongate, moderately fusiform and slightly flattened. Anterior tibiae tridentate. Tibiae of hind pair of legs squarely truncate, subtriangular in cross-section bearing on the posterior inner angle a longitudinal row of from three to five stout, rather blunt spines and below each spine a long bristle; on the anterior inner angle a stout flattened spine opposite the more distal of the two small spines of the outer angle, bearing from one to three bristles, the distal one with three to five bristles; outer side with but few sparse punctures. Tarsal claws curved and strongly toothed in middle. *Male* with antennal club as long as the funiculus; last abdominal segment ventrally with extensive, sharply margined transverse concavity; both spurs slender, curved, movable, the larger about one third longer than the other. Genitalia with sheath (or "theca" of Smyth) collar-shaped, protractile, chitinous, open ventrally; adnate armatures distinct, chitinous and bifurcate at tip; spicula medial and sharply deflexed ventrally. *Female* with antennal club shorter than the funiculus; last abdominal segment ventrally broader, sparsely punctate and with slight non-margined concavity; pygidium more polished with two tubercles in apical

angle; spurs of rear tibiae much stouter and broadly machete-shaped; genitalia with prominent pubic process.

at Manatí (845–12, 226–12), Barceloneta (226A–16), Garrochales (241 & 242–16), Arecibo (145–16, 225–16), San Sebastián (436–13), Añasco (373–12, 1018–13), Hormigueros (817–15), Guánica (TYPE locality) and Yauco (very many records).

Phyllophaga (Lachnosterna) portoricensis Smyth, E. G., 17–145; TYPE from Río Piedras, Porto Rico: "The eastern analogue *P. vandinei* ----- its distribution -- approximately the eastern two-thirds of the Island." Has the same feeding habits as *P. vandinei* and one year cycle.

(as *Ancyloncha crenticollis* Blanchard) Stahl.

Wetmore 16–11: the "múcaro" or Bare Legged Owl, *Gymnasio n. nudipes* is the most important bird feeding on the adults, as they constituted 24.4% of its stomach contents, the Mozambique, *Holoquiscalus brachypterus*, feeds on the grubs (1.61% of the stomach contents) and the Little Blue Heron on adults (1% of stomach contents).

Redescribed by J. D. More. Much the same as the preceding species, but is usually somewhat greater in size, averaging 1 to 2 mm. more in length, is darker in color, the surface typically somewhat more polished. The male genitalia having the adnate armatures spatulate at the tip instead of bifurcate; spicula roundly deflexed ventrally instead of sharply. The pygidium of the female with the two tubercles in the apical angle often faint or absent.

at Fortuna (366–13), Aguirre (515–12, 380–13), Santa Isabel (943–13), Humacao (101–15), Fajardo (463–12), Vieques Island (67–17–"somewhat larger and lighter in color"), Luquillo (198–13, 945–13), Mameyes (176–13), Río Piedras (many records–TYPE locality), San Vicente (99–15, 225–15).

Phyllophaga (Lachnosterna) citri Smyth, E. G., 17–159; TYPE from Río Piedras, Porto Rico: One year life cycle, grubs often abundant in sandy land of north coast, feeding on roots of citrus trees, adults feed on leaves of citrus, rose, *Psidium guajava, Grevillea robusta, Acalypha wilkesiana, Miconia racemosa, Clidemia hirta, Lantana camara, Triumphetta* sp., *Urena lobata,* and others which are eaten by *P. vandinei* and *P. portoricensis*.

Redescribed by J. D. More. Oblong, convex, broader behind. Male dull brown, elytra with plumbeus bloom, female with less bloom, posterior half of elytra polished chestnut brown; thorax rich mahogany brown; head darker. Length 14 to 17 mm. Head rather coarsely and densely punctate except at base. Clypeus feebly emarginate, margin narrowly reflexed. Thorax less densely punctate, convex, distinctly narrower in front, sides obtusely angulate, widest a little to the rear of the mid-

dle, narrowed slightly towards base, more obliquely narrowed in front, anterior margin ciliate, lateral margins anteriorly crenate and ciliate, posteriorly entire and cilia lacking, posterior margin entire. Elytra punctured as densely as thorax, finely and scarcely pubescent, sutural costa well marked and punctured, discal costae nearly obliterated or wanting. Metasternum more coarsely and not so densely punctured as in *vandinei*, hair rather sparse. Posterial ventral margin of the fifth abdominal segment as in *vandinei*. Pygidium dull, densely and closely punctate, finely and scarcely pubescent. Antennae nine jointed. Last joint maxillary palpus elongate, moderately fusiform and slightly flattened. Anterior tibiae tridentate. Tibiae of hind pair of legs squarely truncate, moderately coarsely but scarcely punctured on the outside, spines as in *vandinei*. Tarsal claws curved and strongly toothed in the middle. *Male* with antennal club as long as the funiculus; last abdominal segment ventrally with a transverse impression extending to the lateral angle, granulate and somewhat narrowed medially; spurs movable, of nearly equal length, slender, blunt and curved. Genitalia with sheath collar-shaped, protractile, chitinous and open ventrally; adnate armatures fused into single spatha, spatha depressed, chitinous and polished above, unsymmetrical, hooked upwards on the left side and terminating in a serrate edge; spicula dextral. *Female* with antennal club shorter than the funiculus; last abdominal segment ventrally broader with slight transverse impression, granulate with smooth polished anterior and posterior margins; smaller hind tibial spur curved, usually broader and blunter and of uniform width; genitalia without prominent pubic process.

at Aguirre (304–15), Aibonito (1304–13), Mameyes (817–12), Vieques Island (68–17), Río Piedras (many records–TYPE locality), Vega Alta (339–17), Barceloneta (227A–16), Garrochales (242–16, 247-16), Arecibo (146–16, 225A–16), Aguadilla (448–13) and Añasco (372–12, 1008–13).

Phyllophaga (Lachnosterna) guanicana Smyth, E. G., 17–152; TYPE from Guánica, Porto Rico: adults from February to July, with maximum abundance of beetles in late April, feeding on leaves of *Lantana camara*, *Cordia cylindrostacha*, *Bucida buceras*, *Psidium guajava* and *Hamelia* sp., grubs feed on grass roots in upland pastures.

Redescribed by J. D. More. Similar in general appearance to *citri*. Elytra of the female polished chestnut brown with sometimes a trace of bloom. Length 13 to 17 mm. Elytra sparsely ciliate becoming more dense along the lateral margins. Pygidium densely but not closely ciliate. *Male* with adnate armatures of genitalia fused into single spatha, spatha thicker vertically than horizontally, bilaterally symmetrical, fleshy with

the exception of the two rows of minute, prostrate spinules on the dorsal and ventral surfaces.

at Guánica and Yauco (TYPE localities—many records).

Phyllophaga crinitissima sp. nov.

Described by J. D. More. Oblong, cylindrical, almost uniformly dull brown in color with margins slightly lighter, elytra posteriorly and laterally covered with a slight bloom and few short cilia. Length 9 mm. Head coarsely and densely punctate except at base. Clypeus feebly emarginate, margin narrowly reflexed. Thorax not so densely or coarsely punctured as head, distinctly narrower in front, convex, sides obtusely angulate, widest a little to rear of the middle, rather *densely covered with long cilia;* lateral margins scarcely crenate, ciliate with long hairs; disc with few long hairs. Elytral punctures somewhat finer than those of thorax; sutural costa well marked, margins punctate except inner at base. Metasternum densely and coarsely punctate, covered with long hairs. Abdomen with posterior ventral margin of fifth segment as in *vandinei;* last segment ventrally as in *citri.* Hairs on legs and ventral side of body very long. Pygidium dull, with slight bloom, punctured as thorax, posterior margin reflexed and with a single row of long hairs. Antennae nine jointed, club as long as funiculus. Last joint of maxillary palpus elongate, fusiform and slightly flattened. Anterior tibiae tridentate. Tibiae of hind pair of legs with spine arrangement as in *vandinei,* outer side with few punctures. Spurs movable, the larger about one-third longer than the other, slender, smaller spur slightly curved. Tooth of tarsal claw wanting (this character might be taken for the formation of a new genus). Described from a single male (83–16) at light at Pt. Cangrejos, P. R., Feb. 2, 1916, G. N. Wolcott coll. Female unknown.

Phytalus apicalis Blanchard—det. F. S. Arrow

(as *Phytalus insularis* Smyth, E. G., 17–163; TYPE from Guánica, Porto Rico): on *Amaranthus* spp. and *Panicum barbinode.*

(as *Phytalus insularis* Smyth) Wolcott 22d–14: third instar larvae as host of *Elis haemorrhoidalis* Fabr.

at light (183–15, 643–16, 113–12, 20–18); (943–16, 5–21), at Aibonito (922–15); at Garrochales on *Lantana involucrata* (241B–16); at Pt. Cangrejos on *Phyllanthus nivosus* Bull. var. *roseopictus* (GNW); at Guánica (many records).

Dyscinetus barbatus Fabricius

(as *Chalepus*) Stahl. Gundlach.

Van Z. (316) on sugar cane.

Smyth 16–47: life history summary.

common at light on north side of the island (77–11 det. Schwarz, 198–11, 610–12, 279–13, 459–13, 63–19), at Caguas

(SSC), at Ciales (653–21), at Añasco (509–13); rare at Guánica (1056–13, 332–15). Larvae feed on decaying vegetation in soil.

Dyscinetus trachypygus Burmeister
(as *Chalepus picipes* Burm.) Gundlach.
(also as *D. picipes* Burm., not in synonymy) Leng & Mutchler 17–208.
Van Z. (316) on roots of "malojillo", *Panicum barbinode.*
Smyth 16–47: life history summary.
Smyth 19–120: adults feeding on roots of sugar cane at Carolina.
common at light (611–12 det. Schwarz, 746–14, 64–19, 435A–19, 368–22), at Carolina (708–17), at Mameyes (202–13), at Humacao (60–13), at Barceloneta (465–13), at Arecibo (95–13, 148–16), at Guánica (506–13, 1055–13, 1685–13, 221–15).

Ligyrus tumulosus Burmeister
(as *Ligyrus fossulatus* Latr. det. Chevrolat) Gundlach.
Leng & Mutchler. Van Z. (318) on roots of sugar cane.
Smyth 16–47: life history summary.

		Larva				
	Egg	1st instar	2d instar	3d instar	Pupa	Total
Dyscinetus barbatus	13 days	19 days	28 days	59 days	15 days	—144 days
Dyscinetus trachypygus	12 days	22 days	15 days	44 days	13 days	—104 days
Ligyrus tumulosus	13 days	13 days	15 days	27 days	14 days	— 77 days

The grubs usually feed on decaying vegetation in sandy soil, especially cane stalks, but injury to live roots is accidental. The adults sometimes bore into the base of live cane stalks.
Wolcott 21–43: "1% of 50,000 stalks of cane examined" thus injured, at Vega Baja, Barceloneta, Camuy, Yabucoa, Humacao and Guayanilla.
at light (3–13, 271–13, 3–19), at San Juan (35–11), at Manatí (174–15), at Barceloneta (464–13), at Arecibo (96–13, 147–16), at Guánica (46–10, 21–13, 776–13); in soil around cane seedlings (484–12 det. Schwarz 743–12), in plowed land at Mameyes (818–12); larvae parasitized by *Campsomeris dorsata* Fabr., at Guánica, H. Bourne collector (491–13).

Strataegus quadrifoveatus Palisot de Beauvois The Coconut Rhinoceros Beetle.
(as *S. laevipennis* Chevrolat) Stahl. Gundlach, "acaso nombre manuscrito."
Leng & Mutchler. AMNH at Mayagüez.
Smyth 19–123: adults boring into stalks of sugar cane and young coconut palms.
Smyth, E. G., "The White Grubs Injuring Sugar Cane in Porto Rico, II, the Rhinoceros Beetles." Jour. Dept. Agr., P. R.,

Vol. 1, No. 2, April, 1920, pp. 1–31, pl. 4: an extended account of this and the following species.

Wolcott, G. N., & Seín, F., "Los Caculos Cornudos o los Escarabajos Rhinocerontes de Puerto Rico." Circ. 58, Insular Experiment Station, Río Piedras, P. R., 1922, pp. 1–13, pl. 4: a summary in Spanish of the paper by Smyth.

at light (133–11, 213–13, 104–15, 307–16, 868–16), at Aguirre (5–12), at Adjuntas (FS & GNW); injuring young coconut palm trees by burrowing into them below the soil (285–22), at Sabana Llana (108–18, 99A–18, 16–18, 401–19, 184–21), at Loíza Viejo (192–21), at Manatí (136–16); burrowing up into cane stalk (108–18, 520–19); larvae from soil around cane at Guánica (2–10); in filter-press cake or cachaza (14–21); in interior of rotten coconut palm at Loíza Viejo (259–16).

Strataegus titanus Fabricius The Sugar-Cane Rhinoceros Beetle.
(as *Scaraboeus*) Ledru 1780.

Gundlach. Leng & Mutchler. AMNH at Martin Peña and Fajardo.

Van Dine 13–42: grubs eating cane roots at Guánica, Ponce, Fortuna, Santa Isabel and Aguirre on south coast.

at light (336–13, 449–13, 468–13, 123–15, 182–15); in rotten tree at Dorado (713–13); larvae at base of rotten fencepost (323–13); larvae from soil around cane roots, sometimes attacking live roots at Guánica (4–10), at Santa Isabel (85–11, 848–14), at Fortuna (929–13), on Vieques Island (69–17); larvae attacking seed cane at Guánica (GNW).

Grubs feed on rotten wood and roots and stumps of trees in the soil, old cane stalks and decaying cane seed, but attack live roots only when other sources of organic matter are lacking; the food of the adults "consists largely of the green parts of woody plants and young trees" (Smyth). One year life-cycle.

Phileurus didymus Linnaeus—det. Schwarz

in termite nest, *Nasutitermes morio* Latr., at Ciales (242B–16, 467–21); at Mayagüez (813), R. H. Zwaluwenburg, collector.

Homophileurus quadrituberculatus Palisot de Beauvois
(as *Phileurus*) Gundlach, "La larva vivió en el nido o bulto de *Termes morio.*"

Leng & Mutchler.

LUCANIDÆ.

Passalus pentaphyllus Palisot de Beauvois
Ledru 1780. Stahl.

(several unlabeled specimens).

Spasalus puncticollis Serville
(as *Passalus dentatus* Fabr.) Ledru 1780.
(as *Passalus* sp.) Gundlach.
Leng & Mutchler.
larvae and adults in rotten log at Yauco (308–21); at Mayagüez (617), R. H. Van Zwaluwenburg collector.

CERAMBYCIDÆ.

Parandra cribrata Thomson
Leng & Mutchler.

Parandra cubaecola Chevrolat
Leng & Mutchler.
(as sp.) Wetmore 16–69: eaten by Owl.

Stenodontes bituberculatus Palisot de Beauvois
(as *Nothopleurus*) Leng & Mutchler.
in burrow of live guacima tree, *Guazuma guazuma,* at Salinas (76–16); unlabeled specimens probably from Guánica — det. W. S. Fisher.

Stenodontes damicornis Linnaeus
Stahl.

Stenodontes exsertus Olivier
Leng & Mutchler. Van Z. (P. R. 806).

Stenodontes mandibularis Fabricius
Stahl. Gundlach.

Nothopleurus maxillosus Drury
(as *Mallodon*) Gundlach. Stahl.
Leng & Mutchler 17–209: recorded by Gundlach.

Callomegas protelarius Lameere, A., Ann. Soc. Belgique, Vol. 48, p. 66, 1907, TYPE from Porto Rico.
Leng & Mutchler.
resting on stump at Lares (332–21 det. Schwarz).

Callomegas sericeus Olivier
(as *Orthomegas*) Stahl. Gundlach.
Leng & Mutchler.

Solenoptera thomae Linnaeus = **Solenoptera lateralis** Chevrolat
(as *S. lateralis* Chev.) Stahl. (as *Prosternodes*) Gundlach.
Leng & Mutchler. AMNH at Aibonito. Van Z. (P. R. 20).
(as sp.) Wetmore 16–77: eaten by Kingbird.
(145–11, 796–14); on unidentified bush at Fajardo (181–16); on coffee trees or stumps in mountains north of Yauco (240–22); adult and many larvae, mostly small, but many half-grown, in small fence-posts, just under the bark, at Yauco 300–September, 1921); larva in rotten twig of achiote, *Bixa orellana,* at Lares, June 14, pupated July 20, adult Aug. 3, dead September 12 (230–21).

Methia punctata Leconte
Stahl. Gundlach.

Methia necyaalea Fabricius
Leng & Mutchler.

Chlorida festiva Linnaeus
Stahl. Gundlach. Leng & Mutchler.
Van Z. (1213), larvae bore in branches of mango.
Wetmore 16–61: eaten by Ani, *Crotophagus ani.*
common at light (190–11, 556–12 det. Schwarz, 566–12, 620–12, 486–13, 1086–16, 146–17), at Lares (415–22), at Añasco (509½–13), at Guánica (552–13), usually with Uropodid mite nymps on the thorax.

Eburia quadrimaculata Linnaeus
Leng & Mutchler.
(as sp.) Wetmore 16–58, 66, 82, 96, 98, 104, 114: eaten by Cuckoo, Tody, Flycatcher, Vieros, Adelaide's Warbler and Yellow-Shouldered Blackbird.
at Condado (80–11 det. Schwarz), several unlabeled specimens.

Elaphidion irroratum Linnaeus
(as *E. bidens* Oliv.) Stahl. Gundlach, "no lo creo igual *E. irroratum* L."
Leng & Mutchler 17–209: recorded by Gundlach.
at light (479–16), at San Juan (32–14 det. Schwarz), at Guánica (1094–13, 188–15).

Elaphidion cinereum Olivier
Gundlach. (as *E. nanum* Fabr.) Leng & Mutchler 17–209: recorded by Gundlach.
at light at Humacao (59–13), at Vega Baja (478–16), on Vieques Island (GNW). (Specimens from Haina, Santo Domingo determined by Dr. Schwarz as *E. cinereum* Oliv., by Mr. Fisher as *E. nanum* Fabr.)

Elaphidion spinicorne Drury
(? as *Hypermallus spinicornis* Oliv.) Stahl.
Gundlach. Leng & Mutchler.
at light at Guánica (687–13 det. Schwarz), at Humacao (661–17), at Lares (114–22).

Elaphidion tomentosum Chevrolat
Leng & Mutchler 17–209.
at Palo Seco (113–15), at Cayey (25–21 det. Schwarz), at Maricao (387–21).

Heterachthes 4-maculatum Fabricius—det. Schwarz
at light at Guánica (1076–13), at Lares (148–22), at Pt. Cangrejos (GNW — det. Fishcr).

Merostenus attenuatus Chevrolat
(as *Lampromerus*) Gundlach.
Leng & Mutchler 17–209: recorded by Gundlach.

Compsa sp.
Wetmore 16–69, 82: eaten by Owl and Flycatcher.

Cylindera flava Fabricius
(as *Lampromerus pilicornis* Fabr.) Stahl. Gundlach.
Leng & Mutchler 17–209.
at light (91–23), at Condado (66–10 det. Schwarz), at Humacao (662–19), at Guánica (591–13).

Acyphoderes abdominalis Olivier.
(as *Odontocera*) Stahl. Gundlach.
Leng & Mutchler.

Acyphoderes aurulenta Kirby—det. G. E. Bryant
on leaves of *Psidium guajava* at Cayey (211–23).

Euryscelis suturalis Olivier—det. Fisher
at light at Aguirre (68–16).

Neoclytus araeniformis Olivier
Stahl. Gundlach. Leng & Mutchler.
ovipositing in freshly-cut logs of *Inga vera* in the mountains north of Yauco (319- September 8, 1921 — det. Schwarz).

Proecha spinipennis Chevrolat—det. Schwarz
(197–11, 905–14), at Pt. Cangrejos (GNW).

Monochamus titillator Fabricius
(as *Monohammus*) Gundlach.

Lagochirus araeniformis Linnaeus
Stahl. Gundlach. Van Z. (P. R. 805).
at light (296–12, 401–17), at Condado (36–11 det. by Dr. Schwarz as *L. obsoletus* Thomson), at Yabucoa (64–13). (Specimens from Haina, Santo Domingo determined by Mr. Fisher as *L. araeniformis* Linn.)

Leptostylus sagittatus Jacq. Duval
Gundlach. Leng & Mutchler.
(as sp.) Wetmore 16–59, 63, 66, 69, 82, 96, 98, 99, 104, 106, 108, 111: eaten by Cuckoo, Woodpecker, Tody, Owl, Flycatcher, Vieros, Redstart, Warblers and Honey Creeper.
(det. as sp. by Mr. Fisher) at light (181–21); on firewood at Lares (128–21); on *Inga vera* tree at Lares (230–22); in hotel at Mayagüez (32–22); larvae in rotten fence-post at Maricao (414–21), under bark of stump at Dorado (898–13).

Lepturges guadeloupensis Fleutiaux & Sallé—det. G. E. Bryant
Wetmore 16–66: eaten by Tody, *Todus mexicanus*.
in coffee grove at Ciales (220–22 det. Fisher as not being this species); at Vega Alta (GNW); reared from pods of aroma, *Acacia farnesiana* at Boquerón (150–23).

Oreodera lateralis Olivier
Gundlach. Leng & Mutchler.

Probatius umbraticus Jacq. Duval
Gundlach. Leng & Mutchler.

Spalacopsis filum Klug
Gundlach. Leng & Mutchler.
in coffee grove at San Sebastián (101–21 det. Schwarz).

CHRYSOMELIDÆ.

Lema confusa Chevrolat
Stahl.

Lema dorsalis Olivier
Gundlach. Leng & Mutchler. AMNH at Aibonito and Coamo.
swept from grass (63–12 det. Schwarz, 80–12), at Caguas (RTC), at Boquerón (14–23).

Lema nigripes Weise, J., 85–144, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.
(as sp.) Wetmore 16–61, 66, 84, 108, 111: eaten by Ani, Tody, Wood Pewee, Black and White Warbler and Honey Creeper.
swept from grass (62–12), at Cayey (125–16), at Caguas (RTC — det. Schwarz), at Aibonito (SSC), at Ciales (222–22).

Lema poeyi Lacordaire
Stahl.

Lema placida Lacordaire
Stahl.

Lema polita Lacordaire
Leng & Mutchler.
elytra blue, elsewhere black, one specimen (390–12 det. Schwarz).

Chlamys sp.
Wetmore 16–108: eaten by Northern Parula Warbler.

Pachybrachys mendicus Weise, J., 85–183, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.

Pachybrachys praetextatus Suffrian
Leng & Mutchler.

Cryptocephalus krugi Weise, J., 85–148, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.

Crytocephalus nigrocinctus Suffrian,[1] *C. G. L. E., in Linnaea Ent.*, VI, 1852, p. 282, TYPE from Porto Rico.

(as *C. tristiculus* Weise, *J., 85–147, TYPE from Porto Rico, not* in synonymy) Gundlach. Leng & Mutchler.

Gundlach. Leng & Mutchler.

on grapefruit (283–16), at Vega Baja (535–16), at Mayagüez (121–23 R. C. Danforth collector); on sedge (476–16), on mangrove (250–23), on *Inga vera* (80–21); on *Inga laurina* at Lares (154–22); on icaco, *Chrysobalanus icaco*, at Pt. Salinas (51–23); on weeds at Comerío (757–13); on castor bean at Luquillo (97–16); on *Dalbergia hecastophyllum* at Algarrobo (195–22); on tobaccó at Cayey (36–16); on *Carrisa* at Garrochales (411–16), at Vega Alta (111–17); at Aibonito on roses (107–15); on *Psidium guajava* at Juncos (155–16); on Humbolt's willow at Florida (53–21); on unidentified tree at Lares (265–22); on cotton at Algarrobo (195–22), at Quebradillas (220–21); at Aibonito (SSC); on sugar cane at Barceloneta (GNW).

Cryptocephalus spp. (probably mostly *C. nigrocinctus* Suffrian)
Wetmore 16–66 to 125: eaten by Tody, Kingbird, Petchary, Flycatcher, Wood Pewee, Swallow, Martin, Vireos, Redstart, five Warblers and Oriole.

Cryptocephalus perspicax Weise, J., 85–151, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.

bright yellow; prothorax and elytra light brown in color with large yellow spots: feeding on leaves of sea-grape, *Coccoloba uvifera*, at Quebradillas (309–22 det. Schwarz).

brown or piceous; prothorax and elytra darker: feeding

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[1] Mr. Mutchler states (letter of April 18, 1923): "The species *tristiculus* has the thorax thickly and finely punctured with a few somewhat larger punctures intermixed, fairly shining, while in *nigrocinctus* the thorax is not mirror smooth but fairly thickly and very finely punctulate, shining. The original description of *nigrocinctus* also speaks about the pale mark on the central portion of the basal segment of the abdomen, there is no allusion to this spot in the description of *tristiculus*." After an examination of the extended series of specimens of the two supposed species, it was found that there was no constant relation between the smoothness and punctation of the prothorax and the pale mark on the central portion of the basal segment of the abdomen, and also, all variations were found in the size and intensity of this mark, from a large pale spot occupying the entire central portion of the basal segment, light yellow in color, progressively becoming smaller and more restricted posteriorly and darker in color, dark yellow to reddish-brown, to its ultimate disappearance. From the data available, there appears to be no constant character of separation, and the two names refer to extreme variations of a single species.

On July 4, 1923, a series of thirty specimens (250–23), singly and in coitu, was collected on the leaves and terminal shoots of mangrove on the shores of Laguna San José, near Río Piedras. The twelve males are smaller and four are dull purplish-brown. Two of these have the pale spot on the first ventral segment of the abdomen well marked; it is dull in the third and indistinguishable in the fourth. It is generally well marked in the blue-green males, but one lacks it entirely. Of the eighteen females, which have a well-marked fovea on the fifth abdominal segment ventrally, three have no pale spot, three show it faintly and the remainder quite clearly.

on leaves of *Inga vera* (79–23), at Comerío (755–13); **abundant;** feeding on tender leaves of *Dalbergia hecastophyllum* **at** Pt. Salinas (125–23).

Cryptocephalus polygrammus Suffrian
Leng & Mutchler.

Cryptocephalus stolidus Weise, J., 85–149, TYPE from **Porto Rico.**
Gundlach. Leng & Mutchler.

Cryptocephalus tortuosus Suffrian
Gundlach. Leng & Mutchler.

Cryptocephalus viridipennis Suffrian
Leng & Mutchler 17–210.

Diachus nothus Weise, J., (as **Cryptocephalus**) 85–152, TYPE **from Porto Rico.**
(as *Cryptocephalus*) Gundlach, "No en Cuba, donde vive *C. pusio* Suffrian, que es muy parecido."
Leng & Mutchler.
(as *C. pusio*) Wetmore 16–66, 84, 87, 108, 111: eaten by **Tody,** Elainea, Cliff Swallow, Parula Warbler and Honey Creeper.
in grapefruit grove at Vega Baja (536–16 det. Schwarz); on tender growth of *Inga laurina* at Lares (168–22): **possibly** another species with more coarsely punctate elytra and **lighter** yellow in color, on *Inga vera* (81–21).

Lamprosoma longifrons Suffrian
Gundlach. Leng & Mutchler.

Noda sp. or **Nodonota** sp.—det. Cotton
bronze-black, shining, finely and evenly punctured, each **puncture** with a short white hair, antennae, tibiae and tarsi **brown.**
on sagebrush, *Croton* spp., at Yauco (47–22), at **Boquerón** (95–23).

Colaspis alcyonea Suffrian
Gundlach. Leng & Mutchler.
(as sp. det. Schwarz) on El Yunque at Mameyes (809–12).

Metachroma antennalis Weise, J., 85–155, TYPE from **Porto Rico.**
Gundlach. Leng & Mutchler.
(as sp.) Wetmore 16–104, 108, 116: eaten by Warblers **and** Oriole.
reported as attacking cotton at Quebradillas in June (185–22 det. Dr. Schwarz and Mr. G. E. Bryant); between **leaves** and in spider nests on various plants on the beach at **Arecibo** (165–May 21, 1923).

Metachroma liturata Suffrian
Wetmore 16–116: eaten by Oriole.

Lactocera laevicollis Weise, J., 85–156, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.
on dwarf holly, *Malphighia coccigera,* in the woods at (Seboruco) Pt. Cangrejos (376–22 det. Schwarz, Alice Ames, collector); (235–22 Margaret Lord, collector).

Myochrous armatus Baly—det. G. E. Bryant
(as sp.) Wetmore 16–39, 61, 63, 82, 87, 96, 98, 106, 108, 111: eaten by Killdeer, Ani, Woodpecker, Flycatcher, Cliff Swallow, Vireos, Warblers and Honey Creeper.
on swamp vegetation at Boquerón (175–23).

Galerucella obliterata Olivier
Leng & Mutchler.

Galerucella varicornis Weise, J., 85–157, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.
feeding on leaves of "moral", *Cordia sulcata,* at Mayagüez (253–23 det. Schwarz); on flowers of *Cordia corymbosa* at Sabana Llana (112–15).

Diabrotica aeruginea Fabricius
Leng & Mutchler.

Diabrotica graminea Baly, J. S., "Descriptions of Uncharacterized Species of Diabrotica" *in* Trans. Ent. Soc. London, pt. IV, December 1886, p. 443, TYPE from Porto Rico.
Leng & Mutchler.
Leng & Mutchler 17–211: from Vieques Island.
Van Z. (31) on beans, squash, sugar cane and *Erythrina glauca.*
Van Dine 13–34: on leaves of sugar cane.
Smyth 19–142: "adults feed to some extent on the foliage, and larvae upon the roots" of sugar cane.
Wolcott 21–45: sometimes abundant in cane fields.
Jones 15–5: "very common --- on leaves of sugar cane, --- injury most severe on corn and okra, --- on flowers of cowpeas, --- foliage of *Spondias lutea* and *Amaranthus spinosus.*"
Cotton 16–96 to 98, fig. 3: life-history and control, hosts and technical description and illustrations of all stages.
Cotton 18–302: "attacks almost all vegetable crops, --- very abundant on okra, feeding on the petals, pollen and pistil of the flowers."
Wetmore 16–61, 66, 80, 128: eaten by Ani, Tody, Petchary and Grasshopper Sparrow.
at light at Guánica (588–13); on young leaves of sugar cane at Naguabo (32–10 det. Schwarz), on Vieques Island (GNW), at Humacao (55–13), at Yabucoa (401–12), at Juncos (8A–19), at Caguas in great abundance (GNW), at Toa Baja (141–13), at Vega Alta (81–13), at Arecibo (188–11, 12–15), at San Sebastián (GNW), at Yauco (240–21); on eggplant (44–16), on pistils of eggplant (53–16), on tomatoes (RTC), on corn

(638–17); on corn, cane and especially on beans at Aguadilla (24–22); on orange leaves at San Vicente (709–13); on fruit of *Solanum nigrum* at Luquillo (195–13); at Aibonito (SSC).

Diabrotica bivittata Fabricius
Stahl. Gundlach. (as *D. pallipes* Oliv.) Leng & Mutchler.
Van Z. (903a) on beans and curcurbits.
Jones 15–5: "in abundance on cucumber, squash, and melon, especially on the flowers."
Cotton 18–295: notes.
"smaller than *D. innuba*, legs entirely testaceous, elytral apices not dentate" Dr Schwarz: on leaves of squash and cucumbers (395–12 det. Schwarz).

Diabrotica innuba Fabricius
Stahl. Gundlach. Leng & Mutchler. AMNH at Aibonito.
Leng & Mutchler 17–211 from Culebra Island.
Van Z. (903) on beans and squash. Jones 15–5: notes
Cotton 18–294 to 295: "The beetles lay their small yellow eggs in the soil around the roots of the plants, and the larvae, which are slender, white, worm-like creatures, feed on and tunnel the roots."
"larger than *D. bivittata*, legs partly black, elytral apices dentate" Dr. Schwarz: on leaves of squash and cucumbers (22–12, 395–12 det. Schwarz), (640–17, 642–17), at Caguas (RTC), at Aibonito (SSC); on young leaves of sugar cane at Arecibo (14–15), on pokeweed, *Phytolacca decandra*, in the mountains north of Yauco (241–22).

Diabrotica impressa Suffrian
Stahl. Leng & Mutchler.

Diabrotica quadriguttata Olivier
Gundlach. Leng & Mutchler.

Diabrotica thoracica Fabricius
Stahl.

Blepharida irrorata Chevrolat
Gundlach. Leng & Mutchler.

Cerotoma denticornis Fabricius
Stahl. Gundlach.
(as *C. ruficornis* Oliv.) Leng & Mutchler. AMNH at Coamo, Aguadilla and Guayanilla.
Howard 04–84; Barrett 04–448: on beans and cowpeas.
Jones 15–5: "feeding on garden beans and cowpeas."
Van Z. (902) on beans and squash.
Cotton 18–275: notes and control.
Cotton 16–95 to 96, fig. 2: notes, life-history and control: illustrations of all stages.
abundant on cowpeas and beans (378–12 det. Schwarz, 71–

12, 81–12, 56–16, 138–16, "semi-immaculate adults occur about 1 to 5 of the normal form" 467–16), at Mayagüez (50–23), at Caguas (RTC): on sugar cane at Vega Baja and Guánica (GNW).

Hypolampsis inornata Jacoby—det. G. E. Bryant
on swamp vegetation at Boquerón (186–23).

Homophoeta aequinoctailis Fabricius
Leng & Mutchler 17–211. (as *Oedionychis*) Stahl.
abundant on *Heliotropum indicum* (744–12), at Caguas (124–16), at Boquerón (15–23 det. Schwarz), on Vieques Island (GNW -- det. Schwarz); on grapefruit at Vega Baja (511–16); unlabeled specimen det. Mr C. A. Frost.

Oedionychis bicolor Linnaeus
(as *Altica*) Ledru 1780.
Gundlach. Leng & Mutchler.
on unidentified shrub at Laguna San José, Pt. Cangrejos (319–22 det. Schwarz); very abundant on *Volkameria aculeata* at Pt. Salinas (124–March 17, 1923 det. Schwarz).

Oedionychis cyanipennis Fabricius
Stahl. Gundlach. Leng & Mutchler.
AMNH at Ponce, Tallaboa and San Juan.
Van Z. (P. R. 33) on young leaves of sugar cane.
on *Jussiaea erecta* and *J. suffruitacosa*, "also on *Verbesina, Valerianoides, Pluchea, Physalis* and other plants, being general feeders" E. G. Smyth (464–16, 505–16), at Pt. Cangrejos (320–22), at Mayagüez (122–23 R. C. Danforth, collector), by the lagoon at Lajas (98–15); on leaves of sugar cane (212–11, 29–12 det. Schwarz), at Cayey and Guánica (GNW); on *Volkameria aculeata* at Boquerón (94–23).

Oedionychis decemguttata Fabricius
Gundlach. Leng & Mutchler.

Omototus ferrugineus Suffrian
Gundlach. Leng & Mutchler.
on tender growth of *Inga laurina* at Lares (166–22 det. Schwarz).

Disonycha ambulans Suffrian
Stahl.

Disonycha chlorotica Olivier
Stahl. Gundlach. Leng & Mutchler.

Disonycha interstitialis Suffrian
Gundlach. Leng & Mutchler.
feeding on roble, *Tecoma pentaphylla*, (427–12 det. Schwarz).

Disonycha pallipes Weise, J., 85–159, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.

Disonycha laevigata Jacoby—det. G. E. Bryant
Wolcott, G. N., "An Important New Pest of Beets in Porto Rico" *in* Jour. Ec. Ent., Vol. 16, No. 5, pp. 459–460, October, 1923.
bright orange-red; eyes, antennae except two basal segments, apical half of tibiae, and all of tarsi, black and finely pubescent; elytra bright green, shining, impunctate; on beets (375–22), on "beets, chard, eggplant and many other vegetables" at Mayagüez (120–23, R. E. Danforth collector); on *Amaranthus* at Guánica (242–21); in enormous numbers, resting on cane and beans at Guánica (39–23 det. Bryant); on *Philoxerus vermiculatus* at Hatillo (239–23).

(**Haltica apricaria** Mus. Berlin
Stahl.)

Haltica gravidula Suffrian
Gundlach. Leng & Mutchler.
possibly this species, about 3 mm. long, elytra very minutely punctured: millions of adults resting on leaves of tree on hill northeast of Guayama (50- January 23, 1922).

Haltica jamaicensis Fabricius
(as *Haltica plebeja* Oliv.) Gundlach.
(as sp.) Wetmore 16–39, 66, 87: eaten by Killdeer, Tody and Cliff Swallow.
Leng & Mutchler. AMNH at Aibonito and Coamo.
Cotton, R. T., "Life History of *Haltica jamaicensis* Fabr." Jour. Dept. Agr. P. R., Vol. 1, No. 3, July 1917, pp. 173–175: eggs, larvae and adults on *Jussiaea leptocarpa*, *J. suffricticosa* and *J. erecta*, sometimes adults feed on garden beans. Pupa in ground, 39 days from egg to adult, females lay 500 to 800 eggs.
on *Jussiaea* (41–12 det. as *H. plebeja* Oliv. by Dr. Schwarz, 153–13, 165–13, 167–13, 168–13), at Manatí (110–16), at Barceloneta (GNW), at Aibonito (SSC).

Haltica occidentalis Suffrian
Stahl. Gundlach. Leng & Mutchler.
at light at Guánica (571–13); on *Jussiaea* (250–12 det. Barber & Schwarz, 42–13, 438–17, 503–16), at Manatí (111–16); on leaves of sugar cane, presence probably accidental, at Toa Baja (142–13), at Guánica, Bayamón and on Vieques Island (GNW).

Hermaeophaga cylindrica Weise, J., (as *Haltica*) 85–160, TYPE from Porto Rico.
Leng & Mutchler. (as *Haltica*) Gundlach.
very abundant on leaves of *Croton humilis*, *C. discolor* and other species of *Croton*, unevenly skeletonizing them, at Ponce (111–13 det. Schwarz), at Yauco (136–15, 48–22).

Lactica scutellaris Olivier
Gundlach. Leng & Mutchler.
swept from weeds (773–13, 475–16, 419–17); on *Trema micranthum* in mountains north of Yauco (321–21 det. R. T. Cotton).

Lactica sp.—det. Schwarz
black, legs and antennae brown, about 2 mm. long, on *Caperonia palustris* (579–12).

Crepidodera asphaltina Suffrian
Gundlach. Leng & Mutchler.

(**Crepidodera hirtipennis** Stahl.)

Homophyla krugii Weise, J., 85–163, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.

Aedmon sericellum Clark
Leng & Mutchler.

Epitrix cucumeris Harris The Black Flea-Beetle of Tobacco of Porto Rico. "La Pulga Negra" of tobacco-growers.
(as *E. fuscata* Jacq. Duval) Gundlach.
(also as *E. fuscata* J. Duval, recorded by Gundlach, not in synonymy) Leng & Mutchler 17–211.
Van Z. (1103) on tobacco leaves.
Jones 15–6: on eggplant, tomato and *Physalis.*
Merrill 16–50: on tobacco, control.
Cotton 18–310: on tomato.
Cotton 16–87: life-history, food-plants and control.
More, J. D., "Las Pulgas del Tabaco" Circ. 50, Insular Experiment Station, Río Piedras, P. R., October, 1921, pp. 1–8, fig. 3.
Wolcott 21–45: one on sugar cane at Aguadilla.
on *Physalis angulata* (201–12 det. Schwarz), on tomato (405–13); on potatoes at Jajome Alto (20–21); on tobacco at Aibonito (67–12, and SSC — det. Schwarz).

Epitrix parvula Fabricius
Gundlach. Leng & Mutchler.
Wetmore 16–87: eaten by Cliff Swallow.
Van Z. (1104) on tobacco.
Merrill 16–50: on tobacco, control.
Jones 15–6: on *Physalis.*
Cotton 16–88: food-plants, life-history and control.
Cotton 18–298: on eggplant.
More 21–6, fig. 2, a: notes.
Wolcott 21–45 abundant on sugar cane at Garrochales and Morovis.
on *Physalis angulata* (200–12 det. Schwarz); on tobacco at

Aibonito (SSC); "on *Cleome spinosa, Leptilon canadense, Lycopersicum esculentum, Solanum nigrum, Solanum torvum,* tomato and eggplant" R. T. Cotton.

Chaetocnema apricaria Suffrian
(as *Plectroscellis*) Stahl. Gundlach.
Leng & Mutchler.
Leng & Mutchler 17–212: from Vieques Island.
(as sp.) Wetmore 16–61, 106, 108: eaten by Ani, Yellow and Parula Warblers.
Jones 15–6: on sweet-potato and abundant on related weed.
on wild morning-glory (562–12 det. Schwarz); on sweet-potato at Comerío (765–13); abundant on *Ginoria rohrii* at Boquerón (173–22 det. Schwarz); making brownish curved slits in the underside of the leaves of mangrove at Mayagüez and at Martin Peña (GNW).

Chaetocnema nana Jacoby—det. G. E. Bryant
from grass growing on salty land at Salinas (244–21).

Systena basalis Jacq. Duval "La Pulga Americana" of tobacco-growers.
(as *Haltica basilea* Jacq.) Stahl.
Gundlach, "Ambos sexos difieren mucho."—or, more correctly, the sexes differ considerably from each other, the males are smaller and on each elytron have a broad median longitudinal golden band; the females have faint basal and apical spots on the elytra.
Howard 04–84; Barrett 04–448: on Russian sun-flower.
Leng & Mutchler. Van Z. (931) on beans, okra and beets.
Cotton 16–90 to 93, fig. 1: life-history, host-plants, control and illustrations of all stages.
More 21–5: same in Spanish.
Wolcott 21–45: abundant on sugar cane at Aguada, Aguadilla and San Sebastián in December, 1919.
Wetmore 16–39, 87, 106, 114, 119, 128: eaten by Killdeer, Cliff Swallow, Yellow Warbler, Yellow-Shouldered Blackbird, Mozambique and Grasshopper Sparrow.
on *Portulaca oleracea* (480–12 det. Schwarz, 481–12), on carrots and other vegetables (547–17), on tomatoes and eggplant (RTC), on *Valerianoides cayannensis, Verbesina alata, Pluchea* and *Borreria* (504–16); on *Lantana camara* and *Melochia* sp., abundant on *Pluchea odorata* at Cayey (249–21); on *Bidens pilosus leucanthus* and *Syndrella nodiflora* at Comerío (766–13); on tobacco at Aibonito (SSC); on corn, cane and especially on beans at Aguadilla (30–22); on sugar cane at Aguada and San Sebastián (GNW).

Systena varia Weise, J., 85–164, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.
(as sp.) Wetmore 16–87: eaten by Cliff Swallow.

Longitarsus (?) seminulum Suffrian—det. G. E. Bryant
on grass in saline waste at Salinas (245–27).

Longitarsus varicornis Suffrian
Gundlach. Leng & Mutchler.
very abundant on *Heliotropum indicum* (449–12 det. Schwarz, 463–16), at Caguas (113–21).

Glyptina sp.
Wetmore 16–66: eaten by Tody, *Todus mexicanus.*

Phyllotreta fallax Suffrian
Gundlach. Leng & Mutchler.

Phyllotreta guatemalensis Jacoby—det. G. E. Bryant
black or blue-black; prothorax and elytra dark blue, evenly and densely punctured; head dark blue-green, narrower than prothorax, which is not as wide as single elytron; length 2 mm.
abundant on *Cleome pentaphylla* at Mayagüez (123–Feb. 11, 1923, R. E. Danforth collector).

Aphthona compressa Suffrian
Gundlach. Leng & mutchler. AMNH at Aibonito and on Desecheo Island.
with blue elytra, on *Heteropteris laurifolia* (251–12 det Schwarz); at Pt. Cangrejos (135–23), at Vega Baja (537–16), at Caguas (GNW); very abundant on *Volkameria aculeata* at Boquerón (84–23); one with purple elytra, on coffee at Utuado (474–21); another on *Inga laurina* at Mayagüez (252–23), these the true *A. compressa* det. G. E. Bryant

Aphthona maculipennis Jacoby
Leng & Mutchler 17–212.
on *Phyllanthus lathyroides* (869–14 det. Schwarz).

Megistops fictor Weise, J., 85–162, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.

Chalepus sanguinicollis Linnaeus
(as *Odontota axillaris* Dej.) Stahl. Gundlach.
Leng & Mutchler.
Leng & Mutchler 17–212: from Vieques Island.
on weeds (474–16, 406–17), at Vega Baja (515–16 det. R. T. Cotton).

Ochthispa loricata Weise, J., 85–166, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.

Mesomphalia exclamationis Linnaeus
Gundlach. Leng & Mutchler.
(as sp.) Wetmore 16–59: eaten by Cuckoo.

Chelymorpha argus Lichtenstein, var. **geniculata** Dejean
Gundlach. Leng & Mutchler. Cotton 18–309: on sweet-potato.

Chelymorpha polysticha Boheman
Gundlach. Leng & Mutchler.
on wild morning-glory, *Ipomoea* (835–14); on sugar cane at Juncos (659–17 det. Schwarz); on eggplant at Juncos (RTC).

Coptocycla bisbinotata Boheman
Gundlach. Leng & Mutchler.

Coptocycla glaucina Boheman
Leng & Mutchler.

Coptocycla guttata Olivier
Stahl. Gundlach. Leng & Mutchler.
(as *C. signifera*) Wetmore 16–61, 79, 87, 91, 114, 116, 128: eaten by Ani, Kingbird, Cliff Swallow, Mockingbird, Yellow-Shouldered Blackbird, Oriole and Grasshopper Sparrow.
(as *Caprocyla signifera* Herbst) Jones 15–6: on sweet-potato.
Cotton 18–307: on wild mornig-glory and sweet-potato leaves.
on wild morning-glory at Caguas (102–16, 247–21), at Juncos (660–17); on sugar cane, accidentally, at Yauco (314–21).

MYLABRIDÆ (BRUCHIDÆ).

Pachymerus giganteus Chevrolat (**curvipes** Fabr. ?)
Leng & Mutchler.

Bruchus centromaculatus Allard (? **cinerifer** Sch.)
(as *B. cinerifer* (Chev.) Sch.) Gundlach, "se encuentra en la flor de Júcaro, *Terminalia.*"
Leng & Mutchler.

Bruchus chinensis Linnaeus
Leng & Mutchler. Van Z. (1511) in stored cowpeas and beans.
Wolcott 22b–5: notes.
in dried cowpeas from Virginia at Ponce (335–19); at light at Guánica (593–13).

Bruchus obtectus Say
Van Z. (1504) in beans. Wolcott 22b–5: notes.
in beans (515–17), from Venezuela (155–17).

Bruchus pectinicornis Linnaeus
Stahl.

Bruchus livens Suffrian—det. Schwarz
on arrows of sugar cane (378–22).

Bruchus pisorum Linnaeus
Wolcott 22b–5: notes.
in peas from Spain (1029–16).

Bruchus quadrimaculatus Fabricius, var. **barbinicornis** Fabricius
Leng & Mutchler. Wolcott 22b–5: notes.
in peas from Georgia (135–11); in cowpeas (611–17), at San Juan (97–19), at Ponce from New York (336–19, 544–19).

Mylabris rufimanus Boheman—det. E. G. Smyth
in broad beans from Spain (1031–16 — no specimens).

Bruchus dominicanus Jekel—det. G. E. Bryant
(as *Bruchus* sp.) Wetmore 16–75: eaten by Jamaican Black Swift.
from pods of algarroba, *Hymenia courbaril* (62–11); from pods of aroma, *Acacia farnesiana* at Guánica (42–14, 44–14), at Boquerón (110–23).

Spermophagus pectoralis Say
Wolcott 22b–5: notes.
in beans (151–17), from Venezuela (619–17).

Zabrotes sp.
Wetmore 16–82, 84, 108: eaten by Flycatcher, Wood Pewee and Parula Warbler.

BRENTIDÆ (BRENTHIDÆ).

Trachelizus linearis Suffrian
Gundlach, "debajo cortezas."
(unlabeled specimens, entirely dull, dark brown, determined as sp. by Dr. Schwarz.)

Belophorus maculatus Olivier
Leng & Mutchler. AMNH at Aibonito.
on coffee leaf at Ciales (233–22 det. Schwarz).

Belophorus militaris Olivier
Gundlach, "debajo de la corteza muerta".

Brentus turbatus Boheman
Stahl. Gundlach. (as *Brentus nasatus* F.) Ledru 1780.

Brentus volvulus Fabricius—det. Schwarz
under bark of decaying bucare tree, *Erythrina glauca*, at Cayey (166–16, 244–17, 357–22); under bark of mango tree at Añasco (508½–13); on coffee leaves leaves at Yauco (143–21); at Corozal (136–22), at Aibonito (SSC).

PLATYSTOMIDÆ (ANTHRIBIDÆ).

Brachytarsus sp.—det. Schwarz
from pods of *Acacia farnesiana* at Boquerón (138–23).

CURCULIONIDÆ.

LITERATURE.

Chevrolat, L. A. Auguste de, Note *in* Ann. Ent. Soc. France, Ser. V, Vol. 6, Bulletin, pp. 227–229, 1876.

Fischer, von W. G., "Drei neue *Anthonomus*" *in* Berliner Ent. Zeitschrift, Vol. 32, pt. 2, pp. 487–489, 1888.

Marshall, Guy A. K., "Some Injurious Neotropical Weevils (Curculionidae)" *in* Bull. Ent. Research Vol. 13, pt. 1, pp. 59–78, pl. 2, fig. 4, May 1922.

Wolcott, G. N., 22a–1 to 20 "Vaquitas de Importancia Económica en Puerto Rico." Circ. No. 60, Insular Experiment Station, Río Piedras, P. R., pp. 1–20, fig. 20, October 1922.

Attelabus coccolobae sp. nov.

Shining, robust; color, dark purplish-red, tending to become, especially in the male in more heavily chitinized portions, dark bronze-green. The basal half of the median and posterior femora light yellowish-brown, apical half in female and tarsi of both sexes light reddish-brown.

Beak near apex as broad or broader than head, even at base, narrowed from base to beyond insertion of antennae. Antennae, of male shorter than head, of female considerably longer than the head, with a few short, black hairs, two basal joints moniliform, the second the smaller, the next six joints elongated but gradually becoming more moniliform, the club, apparently 4-jointed, densely and finely pubescent, color of basal segment black, of terminal three light grey. Head elongate, especially in the female and almost as broad behind the eyes as at base, somewhat tapering and shorter in the male; wrinkled and pitted in front, a deep furrow between the prominent black eyes, terminating in the lobe overhanging the insertion of the antennae; finely transversely reticulate beneath and at base. Thorax roughly transversely rugose and somewhat pitted, the anterior, comparatively smooth but somewhat pitted margin separated by a deep depression; a narrower and more irregular, doubly depressed posterior margin. Mesothorax and metathorax beneath more or less roughly pitted, the abdomen beneath, and the pygidium also finely ciliate. Elytra with rows of large, deeply impressed, quadrangular punctures, becoming smaller and tending to coalesce into striae towards apex and along margins: a large, short, blunt tooth posterior of smooth area on humeri.

Anterior coxae roughly punctate in front, smooth behind; the anterior femora smooth, shining, faintly reticulate, finely and scantily ciliate on inside, greatly dilated into a rounded club, more gently tapering towards base, with two large teeth on ventral margin, in the female the largest tooth, blunt and irregularly curved, is at the greatest circumference of the femora and inserted at right angles to the smaller sharper tooth near the apex, in the male they are smaller and approximately parallel, the apical tooth being the larger. Anterior tibiae of the female as long as the femora, scythe-shaped, with a blunt tooth at inner apex, a sharp curved claw at outer apex; of the male less curved except at base, but with bluntly-toothed inner margin. Length 5 to 6 mm.

Described from a pair, found feeding on tender leaves of sea-grape, *Coccoloba uvifera*, at Pt. Salinas, Jan. 4, 1923, Acc. 54–23.

Wolcott 22a-6: method of oviposition and notes.

on host at Pt. Salinas (231–16, 66–22, 54–23 TYPE, 127–23). at Pt. Cangrejos (398–22), at Algarrobo (198–22), at Isabela (207–21); at Humacao Playa (286–23).

Attelabus sexmaculatus Chevrolat 76–228, TYPE from Porto Rico.

Stahl, also as *A. aureolus* Klug, which Gundlach states occurs in Cuba, but not in Porto Rico.

Gundlach. Leng & Mutchler.

(as *A. bipustulosus* Jekel) — this is the determination by Dr. W. Dwight Pierce of apparently identical specimens from the same host.

Van Z. (P. R. 1024) on *Psidium guajava* and *Eucalyptus* sp.

Leng & Mutchler 17–217.

Wolcott 22a-6, fig. 1: notes, figure of adult and parasitizm of egg by *Poropoca attelaborum* Girault.

on *Psidium guajava* (330–16 det Schwarz), at Trujillo Alto (GNW — det. Schwarz), at Aibonito (SSC), at Añasco (1040–13); on "almendrò", *Terminalia catappa* (92–21).

Cylas formicarius Fabricius

Jones 15–6: on sweet potatoes. Cotton 18–308: notes.

Cotton, R. T., "*Cylas formicarius* Fabr. in Flight" *in* Jour. Ec. Ent., Vol. 9, No. 5, October, 1916, p. 516.

More, J. D., "La Vaquita o Piche de la Batata" Circular 34, Insular Experiment Station, Río Piedras, P. R., January 1921, pp. 1–7, pl. 1.

Wolcott 22a-7: notes and control, illustration of adult.

at light (114–12, 297–12, 315–12), in *Ipomoea* with tuberous root (584–12), in sweet potatoes (682A–17, 683A–17, 684A–17), at Las Cabezas (94–16), at Fajardo (93A–18, 94A–18), at Isabela (212–21).

Apion subaeneum Gerstaecker, Carl, E. A., "Beschreibung neuer Arten Apion" *in* Stett. Ent. Zeit., Vol. 15, pp. 234–261, 265–280, 1854, TYPE from Porto Rico.

Leng & Mutchler. Leng & Mutchler 17–218: "*Apion portoricanum* Gerstaecker is a synonym of *subaeneum* Gerstaecker (Wagner, Mem. Soc. Belg. 1912, XIX, p. 36)."

(as sp.) Wetmore 16–104: eaten by Adelaide's Warbler

Exophthalmodes roseipes Chevrolat (as **Pachnaeus**) 76–227, TYPE from Porto Rico.

(as *Pachnaeus*) Stahl. Gundlach Leng & Mutchler.

(as the "smaller orange-leaf weevil, or 'green bug' ") Tower 11a–9: "In the San Juan district and near Arecibo – – – in sandy soils – – – January and February – – – eggs in clusters between the leaves – – – number 6 to 24 – – – scarring fruit in in June, 1908 – – – eating the orange leaves, especially the new growth."

Marshall 22–60: generic transfer to *Exophthalmodes.*

Wolcott 22a–18, fig. 19: a general account, figure of adult.

feeding on orange or grapefruit leaves (41–15), at Loíza (191–21), at Pt. Cangrejos (GNW), at (Isabela grove or Plantaje) Pt. Salinas (181–15 det. Marshall), at Vega Baja (496–16), at Espinosa (67–15), at Manatí (153–15, 146–20), at Dorado (70–22), at Santana (212–16), at Arecibo (153–15); on cotton at Isabela (159–21, 215–21); on *Inga vera* (86–21); on *Inga laurina* at Lares (153–21); on *Dalbergia hecastophyllum* and "moca", *Andira inermis,* at Algarrobo (197–22); on injured cotton boll at Loíza (379–22); on icaco, *Chrysobalanus icaco,* at Pt. Cangrejos (391–22); on *Conocarpus erectus* at Pt. Salinas (52–23); on tender leaves of sea-grape, *Coccoloba uvifera,* at Loíza (121–22), 1 mm. longer than the largest *E. roseipes* (10 mm.) and refusing to eat tender grapefruit leaves, but no apparent structural difference; abundant and of normal size on this host at Arecibo (359–23 det. Marshall).

Compsus maricao sp. nov., generic determination by Dr. Marshall.

Integument shining black, densely clothed, except for denuded areas and ridges, with light bluish-green scales, and in punctures and depressions on the thorax and elytra with a superior layer of yellowish-green scales.

Antennae, except club, with bluish-white pubescence and scattering longer white cilia, first and second segments of funiculus subequal in length, other five moniliform, club velvety dark brown. Scales densest on head about eyes, denuded at base and along medio-dorsal longitudinal ridge on rostrum. Rostrun narrowest at eyes, rectilinear at sides, nearly twice as long as broad. Prothorax longer than broad, sides parallel

from base to beyond middle, narrowed somewhat towards apex; above, broadly and deeply depressed, except anteriorly, the depression being about 2.8 mm. long and 1 mm. wide, non-denuded except for a medio-longitudinal line, and surrounded, except posteriorly, by a broad, denuded U-shaped ridge, a slighter and less denuded ridge beneath on each side, not reaching the apex. Elytra elongate oval, much broader at shoulders than the prothorax, almost parallel sided, with a slight concavity just posterior of the humerus, but mostly broadly convex, although again more sharply concave approaching the blunt, curved apical horns, the tips of which are .5 mm. apart. The median margins of the elytra, except towards the apex, and the two adjacent striae of punctures are depressed, also three double and one single, but forked near base, striae; the ridge opposite those on the dorsum of the thorax and that extending from the humerus are most broadly denuded. Abdomen with first, second, third and fourth combined and fifth segments, ventrally subequal in length. Tibiae and tarsi are pubescent.

Length 13 mm.: breadth at humeri 4.5mm.

Described from a single female from Maricao, P. R., Oct. 17, 1921, (388–21) which had laid eggs between coffee leaves. Holotype in the British Museum.

Diaprepes capsicalis Marshall 22–59 and 60, TYPE from Porto Rico: "Integument black or piceous, fairly densely clothed above and below with brown or brownish-grey scaling, often with a coppery reflection; elytra with a pale dot about the middle of interval five. Length 8 – 12mm."

(as *Exophthalmodes*) Wolcott 22a–20: eating "fresas".

on weeds (830–14), on *Eupatorium odoratum* (340–16), eating pepper leaves (568–17, 596–17 TYPE); eating "fresas", the fruit of *Rubus rosaefolius* det. L. H. Bailey, at Jajome Alto (148–21), on ground under fresa bush at Jajome Alto (362–22).

Diaprepes abbreviatus Linnaeus—determined Dr. Guy A. K. Marshall, or

Diaprepes spengleri Linnaeus—determined Dr. W. Dwight Pierce.

(as *Prepodes doublieri* Guerin) Stahl.

(as *D. distinguendus* Boheman and *D. comma* Boheman, not in synonymy) Gundlach, after Chevrolat 76–227.

(as *D. distinguendus* Boheman, *D. comma* Boheman, and *Exophthalmus spengleri* Linnaeus, not in synonymy) Leng & Mutchler.

Pierce, W. Dwight, "Some Sugar Cane Root-Boring Weevils of the West Indies." Jour. Agr. Research, Vol. 4, No. 3, pp. 255–271, pl. 4, June 15, 1915: the "weevil root-borer" of sugar cane in Porto Rico as *D. spengleri* Linn., with three varieties, *abbreviatus* Olivier, *comma* Boheman and *spengleri*

Linn. Reviewed by Dr. Marshall in Rev. App. Ent., Vol. 3, 1915, p. 627: "It is to be regretted that the author has adopted the name *D. spengleri* for the destructive root-borer of sugar cane, seeing that *D. abbreviatus*, L., is not only the older and therefore more correct name, but is also in general use in the West Indies. The name *abbreviatus* should therefore be substituted for *spengleri*."

Marshall, G. A. K., "On New Neotropical Curculionidae" Ann. & Mag. Nat. Hist., Vol. 18, No. 108, December 1916, pp. 449–469: "The variety figured by Mr. Pierce as *D. comma*, Boh., is *D. doublieri*, Guer., the true *D. comma* occurring in Venezuela and Trinidad."

Jones, Thos. H., "The Sugar Cane Weevil Root Borer (*Diaprepes spengleri* Linn.)" Bull. 14, Insular Experiment Station, Río Piedras, P. R., April 14, 1915, pp. 1–19, figs. 11: an extended economic account.

Wolcott 22a–15 to 16, figs. 6: a short economic account, with illustrations of eggs and larva in injured cane (original) and of larva and the three varieties of the adult (after Pierce and with his nomenclature).

Wetmore 16–10: the adults constituted a considerable portion of the stomach contents of the following birds: Petchary 18.47%, Kingbird 17.19%, Flycatcher 11.22%, Mozambique 9.69%, Ani 7.09%. Owl 1.8%, Yellow-Shouldered Blackbird 1.72%, and had been eaten by ten other large birds.

(the varieties vary only in appearance, not in habits or economic importance, although *comma* or *doublieri* is less common than the others and, except in a few cases, will not be specified in the following records) at light (102–11, 89–15), on leaves of sugar cane (5–15, 6–15, 9–15, 27–15), at Mameyes (80–8–12), at Fajardo (128–11), on Vieques Island (GNW —var. *doublieri*), at Yabucoa (71–11, 40–2–12), at Maunabo (517–12), at Santa Isabel (90–11, 415–13), at Aguirre (99–11, 373–13, 786–13, 884–13), at Fortuna (114–11, 115–11), at Guánica (18–10, 331–13, 762–15, 790–15), at Añasco (365–12), at Arecibo (185–11), at Toa Baja (94–15); on grass (20–12), at Humacao (58–10), at Guánica (44–10, 503–13); on celery (61–17); on *Spondias lutea* or "jobo" (993–13, 994–13, 901–14, 97–15) at Luquillo (194–13), at Fajardo (38–15), at Yabucoa (100–15), at Santa Isabel (706A–13), at Arecibo (146–13, 17–15), at Manatí (62–15); on icaco, *Chrysobalanus icaco*, (70–5–13, 901–14, 88–15), at Pt. Cangrejos (26–15); on bucare, *Erythrina micropteryx*, (901–14), at Toa Baja (121–16); on *Ficus laevigata* at Palo Seco (230–16); on leaves of grapefruit (172–16) and on orange at Vega Baja (708–13); on *Cassia tora* (959 to 965–14, 849 to 851–14, 893 to 896–14, 524–16), at Arecibo (524–16); on *Cassia aeschynomene* (290–16); on *Psidium guajava* (899–14, 44–18), at Barceloneta (109–16); on *Persea gratissima* (720–17); on mustard at Bar-

celoneta (82–11); eating leaves and calyx of cotton at Garrochales (305–22); in mountains north of Yauco ovipositing between coffee leaves (384–21); on unidentified tree at Ciales (215–22); feeding on leaves of Humbolt's Willow at Aguadilla (225–22, var. *spengleri*, scales white, but with broad lateral vitta of bright pink or alizarine crimson); on *Mimosa ceratonia* (643–12), at Dorado (714–13); on velvet beans (524–16), on *Amaranthus subspinosus* at Santa Isabel (418–13), at Salinas (32–15); on *Parthenium* sp. at Santa Isabel (418–13); on *Ricinus communis* at Guánica (503–13) and on following hosts listed by E. G. Smyth; *Guazuma guazuma, Tamarindus indicus, Melicocca bijuga, Acnistus arborescens, Schrankia portoricensis* and *Agati grandiflora.*

Larvae attacking roots of sugar cane (395–13), at Luquillo (944–13), at Aguirre (382–13), at Fortuna (364–13, 367–13, 384–13), at Santa Isabel (930–13). Eggs between leaves of sugar cane, and of grass at Santa Isabel (701–13, 847–14), of *Chrysobalanus icaco* (849–14), of *Spondias lutea* at Ponce (GNW).

Prepodes quindecimpunctatus Olivier (? another synonym of *D. abbreviatus*).

Stahl. Chevrolat 76–227. Gundlach. Leng & Mutchler.

Lachnopus coffeae Marshall 22–60 to 61, pl. 1, fig. 8; TYPE from Porto Rico: "Integument piceous, with legs, antennae and apex of rostrum reddish brown; clothed above and below with small, convex, shiny, subcircular or very shortly ovate, white scales - - - mostly not contiguous - - - the elytra usually with three very irregular transverse subdenuded patches. Length 5.5 — 6.25 mm.; breadth 1.8 — 2 mm."

Van Zwaluwenburg 17–515: "the coffee leaf weevil - - - abundant during April and May, feeding on the leaves, blossom buds, and newly set berries - - - one year life cycle - - - eggs in flat masses of fifty or more between two overlapped leaves, larvae - - - feed on roots. Adults also on *Vitex divaricata* - - - a Chalcid (*Tetrastichus vaquitarum* Wolc.) bred from egg cluster."

Wolcott 22a–16 to 19, 3 figs: a more extended account, illustrations of eggs, parasite and adult.

Wolcott 23–46: possibility of control by spraying with Arsenate of Lead, but ordinarily not justified on account of expense.

feeding on tender orange leaves at Pueblo Viejo (149–15), of grapefruit at Isabela Grove, (Plantaje) Pt. Salinas (31–16), at Barceloneta (12–19); on leaves of coffee (44–21 TYPE, 499–21, 416–21 lived in captivity over fifty days, some of the females laying about 30 eggs each, which hatched in ten to fourteen days), at San Sebastián (99–21), in mountains north of Yauco (301–21), between Adjuntas and Utuado (91–22, 269–22), at Ciales (459–21).

Lachnopus coffeae, var. **montanus** Marshall 22–61 to 62, fig. 1; TYPE of variety from mountains north of Yauco, Porto Rico: "This upland race differs from the typical coast form in being somewhat larger and having the legs markedly paler; the scales on the upper surface are much sparser and more evenly distributed, and they are also rather smaller and more nearly circular; most of them being very pale blue or bluish white; on the other hand the stripe of white scaling along the side of the sternum is much denser and more sharply defined. There appears, however, to be no reliable structural difference either in the external characters or in the male genitalia."

Wolcott 22a–16, fig. 16: also at Adjuntas, illustration of adult showing white stripe of scaling along sternum.

Wolcott 23–46: mention.

feeding on tender leaves of coffee in mountains north of Yauco (146–21 TYPE), between Adjuntas and Utuado (484–21, 91–22, 268–22).

Lachnopus spp. nov. (?)

Integument piceous to black, legs and antennae purplish-pink; entirely and evenly clothed with very small convex, shiny, subcircular scales, with no constant areas of denudation. Length 6 - 8 mm.

on tender leaves of *Rapanea ferruginea* in mountains north of Yauco, F. Seín collector (263- Aug. 23, 1922).

Integument light brown to piceous, legs and antennae light yellow to reddish-brown; body and legs, except tarsi, evenly and densely clothed in light yellow, subcircular scales; punctures of elytra devoid of scales. Length 8 mm.

on tender leaves of *Rapanea ferruginea* in mountains north of Yauco, F. Seín collector (264- Aug. 23, 1922).

Lachnopus curvipes Fabricius

Stahl. Chevrolat 76–227. Gundlach. Leng & Mutchler.

Wolcott 22a–20, fig. 20: notes, illustration of adult.

(as sp.—also probably includes *L. coffeae*) Wetmore 16–58 to 128: eaten by Cuckoo, Ani, Owl, Kingbird, Petchary, Flycatcher, Mockingbird, Vireo, Parula Warbler, Honey Creeper, Yellow-Shouldered Blackbird, Oriole, Mozambique, Tanager, Spindalis, Grossbeak, Grasshopper Sparrow.

on *Amaranthus spinosus* (168–16); on undetermined weeds at Dorado (718–13), at Vega Alta (173–15), at Barceloneta (146–15), at Arecibo (279–21), at Yauco (405A–14, 704–14, 315–21), at Guayanilla (402–21); on *Inga vera* at Comerío (756–13); on *Cordia cylindrostacha* at Yauco (521–13) and on *Croton* sp. at Yauco (42–22); on sea-grape, *Coccoloba uvifera* at Loíza (125–22); on *Dalbergia hecastophyllum* at Algarrobo (196–22); on *Waltheria americana* at Boquerón (19–23); on *Conocarpus erectus* at Pt. Salinas (53–23); eating calyx and hiding in cotton squares at Isabela (160–21, 216–

21), at Quebradillas (303–22), at Vega Baja (196–22); eating grapefruit leaves at Manatí (152–15), at Santana (211–16), at Vega Baja (496–16); eating leaves of *Cassia occidentalis* at Yabucoa Playa (287–23).

Lachnopus trilineatus Chevrolat 76–228, TYPE from Porto Rico. Gundlach. Leng & Mutchler.

Lachnopus valgus Fabricius (possibly a synonym of **curvipes**) Gundlach.

Apodrusus argentatus sp. nov.

Integument piceous to black, legs dark reddish-brown; except eyes, antennae, tarsi and punctures and striae of elytra, evenly and closely covered with small, subcircular, silvery scales, interspersed, scantily on head, more thickly on prothorax with black scales.

Antennae yellowish-brown, club darker; scape scantily, funiculus and club densely pubescent; first joint of funiculus large, dilated towards apex, longer than broad, second smaller, third smallest and moniliform, others gradually becoming larger to form club. Head longer than broad, flat between the eyes and with a sharply-defined, scaleless median furrow extending to epistome from near base; eyes elongate, longitudinal, coarsely faceted. Rostrum a little longer than head, tapering to apex, the scrobes deep and extending as far posteriorly as opposite the anterior margin of the eyes. Prothorax almost square, viewed from above, except for slight tapering in anterior quarter and slight dilation towards scutellum. Elytra narrowly oval, sides parallel about half way to apex, wider at shoulders than prothorax; intervals broadly convex and much broader than striae, scarcely a trace of a callosity at apex of interval five. Tenth stria entirely separate from the ninth, although close to it about middle. Usually a rather extensive patch of darker scales on the third elytral interval a little more than half way to apex, a larger one on the fifth interval somewhat anterior, the smallest one on the seventh a little posterior of that on the fifth and one on the ninth two-thirds the distance to the apex. Length 4 — 4.5 mm.: breadth 1.8 — 2 mm.

feeding on leaves of *Guaicum sanctum* at Guánica (703–14) and on *Colubrina colubrina* (EGS); on unidentified host at Aguirre (74–16); on *Dalbergia hecastophyllum* in large numbers at Boquerón (20–23), at Pt. Cangrejos (389–22 TYPE), at Pt. Salinas (126–23).

Apodrusus wolcotti Marshall 22–59, fig. 7, pl. 1; TYPE from Porto Rico: "Integument black or piceous, fairly closely covered above with small, nearly circular, pinkish bluff scales having a distinct coppery sheen; the elytra with sometimes an in-

definite narrow band of dark brown scales behind the middle between striae 3 and 6; the lower surface with coppery grey scaling along the sides of the sternum and venter, the median area with sparse short curved pale squamiform setae."

abundant feeding on *Inga vera* leaves (87–21 TYPE); resting on coffee leaves at Añasco (369–12), in the mountains north of Yauco (302–21), at Jajome Alto (372–21), at Maricao (389–21), at Manatí (GNW).

Heilipus usutulatus Olivier
Leng & Mutchler.

Phyllotrox sp.
Wetmore 16–111: eaten by "Reinita" or Honey Creeper, *Coereba portoricensis.*

Derelomus albidus Suffrian
Gundlach.

Tychius sp.
Wetmore 16–87: eaten by P. R. Cliff Swallow.

Erodiscus sp.
Wetmore 16–39: eaten by Antillean Killdeer.

Anthonomus annulipes Fischer 88–487, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.

Anthonomus dentipennis Chevrolat 76–228, TYPE from Porto Rico.
Gundlach, with *A. krugii* Fischer in synonymy.
Leng & Mutchler.

Anthonomus nigrovariegatus Fischer 88–487, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.

Anthonomus pulicarius Boheman
Leng & Mutchler.
(as sp.) Wetmore 16–84: eaten by Wood Pewee.
Van Zwaluwenburg 16–45: as "a very small, dark, long-snouted weevil in the flower buds of eggplant," notes and control.
Cotton 18–300: "Eggplant Bud weevil - - - feeds on leaves and breeds in the flower buds. Eggs - - - laid in young developing buds and the small white legless larvae develop within the bud, causing it to dry up and drop off."

on wild eggplant, *Solanum torvum,* (403–17), at Cayey (258–21).

Peridinetus concentricus Olivier
Chevrolat 76–229.
(as *P. signatus* Schönherr) Stahl. Gundlach, with *concentricus* in synonymy, and as *P. maculatus* Sturm, not in synonymy.

(and as *signatus* Rosenschoeld, not in synonymy) Leng & Mutchler.
(as *P. poeyi* Jacq. Duval) Leng & Mutchler 17–217. AMNH at Mayagüez.
(as *P. signatus* Rosen.) Van Z. (P. R. 36) on *Piper peltata*. Wolcott 22a–8, fig. 2: "el picudo del higuillo que al comer hace agujeros circulares en las hojas"; illustration of adult.
on *Piper peltatum*, "more abundant on *Piper medium*, make small round holes in leaves, larvae bore in stems of plants" at Vega Alta (40–17 R. T. Cotton); on *Piper medium* at Espinosa (104–21), at Corozal (456–21), at Loíza (119–22), at Cayey (286–22).

Baris torquatus Olivier A. G., "Entomologie" V, Paris, 1907, (83), p. 145, TYPE from Porto Rico.
(as *Baridius*) Stahl.
Chevrolat 76–229. Gundlach.
Leng & Mutchler. AMNH at San Juan and Mayagüez.
Wetmore 16–87, 119: eaten by Cliff Swallow and Mozambique.
Van Zwaluwenburg 16–43: notes and control.
Cotton 18–300: "Eggplant Stem Borer, --- a pest of both wild and cultivated eggplant. Adult feeds on foliage, larva bores in stem and branches --- small, white, oval eggs in a crescentric slit in the stem." Wolcott 22a–8: mention.
on eggplant or *Solanum torvum* (349–12, 731–13, 169–16, 449–16, 504–16, 405–17, 77–21), at Arecibo (441–13), at Guánica (525–13), at Aibonito (SSC), at La Plata (68–12), at Juncos (RTC).

Ampeloglypter cissi Marshall 22–70, pl. 1, fig. 6, TYPE from Porto Rico: "Color uniform dark steel-blue above, the head, rostrum and lower surface blue-black. Length 2 mm."
feeding on tender shoots of *Cissus sicyoides* (161–21 TYPE).

Lecriops psidii Marshall 22–69, fig. 4, pl. 1, TYPE from Porto Rico: "Integument red-brown; the head with a dense edging of pale buff scales between and behind the eyes; the prothorax clothed with rather sparse narrow brownish-yellow scales, --- the median stripe of dense broad white scales on the posterior half, -- the elytra fairly densely covered with mingled pale buff and whitish scales, with an ill-defined curved dark transverse band about the middle ---; the mesosternum, metasternum and abdomen uniformly covered with large subcontiguous white scales. Length 2mm.; breadth .9 mm."
(? 402–16), at Mayagüez (R. H. Van Zwaluwenburg, collector and "H. 1219 — bred from mummied guava") (710–14 TYPE) from *Psidium guajava*.

Hypocoeliodes sp. nov.—det. Schwarz
larvae mining in leaves of *Portulaca* (482–12).

Rhysematus sp.
Wetmore 16–57, 59, 61: eaten by Cuckoos and Ani.

Chalcodermus ebeninus Boheman
Van Z. (1513) on cowpeas.
(as sp.) Wetmore 16–119: eaten by Mozambique.
on cowpeas (70–12, 377–12 det. Schwarz, 76–21); on cane at Arecibo (EGS).

Chalcodermus pupillatus Suffrian
Wetmore 16–119: eaten by Mozambique.

Euscepes batatae Waterhouse The "Scarabee" of Sweet Potatoes.
Van Z. (926) on sweet potatoes and pomelo rind.
Van Zwaluwenburg 15–35: notes and control.
Cotton 18–309: a short account.
Wolcott 22a–7, fig. 5: notes, control and figure of adult.
on sweet potatoes (142–16), at Mayagüez (777–14).

Euscepes porcellus Boheman, Carl H., in Schonherr's "Genera et. Sp. Curculionidum" Vol. 8, pt. 1, Paris, 1844, p. 430, TYPE from Porto Rico.
Leng & Mutchler. Leng & Mutchler 17–217: "redescribed by Leconte under the name *Acalles longulus* (Champion, Biol. Cent. Amer., Col., IV, pt. 4, p. 496)."
Wetmore 16–87 to 128: eaten by Cliff Swallow, Vireo, Redstart, Ovenbird, three Warblers, Honey Creeper, Yellow-Shouldered Blackbird, Oriole, Mozambique, Grasshopper Sparrow.
probably this species: on *Psidium guajava* (281–12); on *Andira inermis* at Lares (53–22).

Gastrocercus ritcheri Fischer
Leng & Mutchler.

Anchonus anguilicollis Chevrolat 76–228, TYPE from Porto Rico.
Gundlach. Leng & Mutchler.
possibly this species: punctures on elytra alternating with elongated warts with erect reddish-brown elongate scales, prothorax, beak and legs consisting entirely of punctures: under loose bark of *Inga vera* at Cayey (364–22).

Anchonus suillus Fabricius
Gundlach. Marshall 22–62, fig. 3, pl. 1: note.
from decayed wood of castor bean, *Ricinus communis*, (232–21); from board on ground (368–21), at Guánica (614–14); from decayed fence post at Naguabo (34–10); at Mayagüez (R. H. Van Z.); eaten by lizzard, *Anolis cristatelus* (296–23).

Cossonus canaliculatus Fabricius
Leng & Mutchler.

Cossonus impressus Boheman
Leng & Mutchler 17–218: from Mona Island.

Cossonus vulneratus Illiger
Leng & Mutchler.

Caulophilus lantinasus Say
Chittenden, F. H., "The Broad-Nosed Grain Weevil" Bur. Ent. Bul. 96, pt. 2, March 31, 1911, pp. 19–24: "February 3, 1899, living beetles were found in about equal numbers with the rice weevil in shelled corn and chick-peas (garbanzos) purchased in a store by Mr. August Busck at Arroyo, Porto Rico."
Wetmore 16–111: eaten by Honey Creeper.

Caulophilus sp.
Wetmore 16–73, 75, 87, 89, 111: eaten by a Flycatcher, Black Swift, Cliff Swallow, Martin and Honey Creeper.
one adult, black but all of elytra reddish-brown; under bark of dead *Bursera simaruba* tree at Vega Baja (114–16); another with only basal third of elytra reddish-brown; on leaves of *Inga vera* at Cayey (317–17).

Nanus uniformis Boheman (in Schönherr)
Gundlach, "Se encuentra frecuentemente en la parte interior de una llagua de Palma real fresca." Leng & Mutchler.

Metamasius hemipterus Linnaeus The Rotten Stalk Borer of Sugar Cane.
(as *Spenophorus sericeus* Latr.) Stahl. Gundlach, "en los troncos muertos de plátano (***Musa***)."
(as *Sphenophorus sexguttatus* Drury) Busck 00–89: injuring sugar cane.
Leng & Mutchler.
Van Z. (305) in sugar cane, coconut palm and *Lantana* sp.
Van Dine 11–55; Van Dine 12–22; Van Dine 13–256; Van Dine 13–33: injurious to sugar cane, but not a serious pest.
Wetmore 16–10: the adults constituted 5.44% of the stomach contents of the Mozambique, 5.3% of the Kingbird, 1.53% of the Petchary, and had been eaten by the Ani, Oriole and Yellow-Shouldered Blackbird.
Smyth 19-142: "sugar cane; dead or injured palm trunks; banana trunks (rarely). Adults sometimes attack fruit."
Wolcott 21–46: attacking injured cane, eggs very rarely laid in injury as small as *Diatraea* tunnel, usually in rat injured cane.
Wolcott 22–48; Wolcott 23–49: larvae in stems of live banana (at Jajome Alto).
Wolcott 22a–10, fig. 7: a short account and illustration of adult.
larvae, pupae and adults in or on sugar cane (23–11, 24–11, 61–11, 163–11, 164–11, 199–11, 133–12, 282–12, 350–12, 393–12, 156–13, 794–13), at Luquillo (191–13, 238–13), at Fajardo

(39–15), at Naguabo (27–14), at Patillas (167–12), at **Santa** Isabel (33–15), at Ponce (166–12), at Guánica (12–10, **13–11** det. Schwarz, 40–11, 236–11, 332–13, 485–13, 500–13, 519–13, 328–15, 363–15, 364–15, 367–15), at Arecibo (309–13), at Barceloneta (39–10), at Manatí (904–14), at Vega Alta (60–10), at Cayey (24–21); in rotting stem of royal palm tree at Arecibo (1066–16); on El Duque at Naguabo, 1600 ft. up (721–14), at Aibonito (SSC); larvae in standing banana stalk at Jajome Alto (31–21).

Cosmopolites sordidus Germar The Banana Root Borer.
Wolcott 22a–11, fig. 8: Wolcott 23–49: discovery, distribution in Porto Rico, life history and methods of control.
one larva from banana at Vega Alta, barrio Malvilla (439–21 the first record in Porto Rico, 628–21 determination confirmed by Dr. Marshall and R. T. Cotton, 547–22), at Corozal (491–21), at Cayey (182–22) and at the Experiment Station (173–22) Río Piedras, at Comerío (275–22), at Barros (?), at Toa Baja (59–23).

Calendra (Calandra) linearis Herbst
(as sp.) Wetmore 16–66: eaten by P. R. Tody, *Todus mexicanus*.
(as *Sitophilus*) Gundlach, "Come las semillas del tamarindo."
in tamarind seed pods at Guánica (535–13, 543–14), at Loíza (345–21).

Calendra (Calandra) oryzae Linnaeus
(as *Sitophilus*) Stahl Gundlach, "muy dañina por la destrucción de los granos del maíz."
Barrett 05–396: parasitized by *Pteromalus calandrae* Howard.
Leng & Mutchler.
Leng & Mutchler 17–218: from Mona Island.
Van Z. (1501) in stored corn, beans, sweet potatoes.
Wetmore 16–96: eaten by Latimer's Vireo.
Wolcott 22a–9, fig. 6, and Wolcott 22b–6: notes, life history and control.
in rice (26–11), in corn (487–12, 434–17, 612–17), at Guánica (615–14) and on foliage of casuarina tree (411–14); under bark of *Erythrina glauca* tree at Cayey (316–17).

PLATYPOIDÆ.

Platypus poeyi Guerin
Gundlach, "Talandra la madera en dirección de la corteza al corazón."

Platypus ratzenburgi Chapuis—det. Hopkins
under bark of logs of *Inga vera* at Lares (133–21).

Platypus rugulosus Chapuis—det. Hopkins
at light at Mameyes (184–13).

Platypus schaumi Chapuis, F., "Monograph des Platypides." Mem. de la Soc. Royale des Sci. Liege, Vol. 20, p. 81, 1866, TYPE from Porto Rico.
Leng & Mutchler.

Platypus subcostatus Jacq. Duval
Gundlach. Leng & Mutchler.

Platypus spp.
Wetmore 16–63, 66, 73, 75, 84, 87, 108, 111: eaten by Woodpecker, Tody, a Flycatcher, *Anthracothorax aurulentus* (7.77% of stomach contents), Black Swift, Wood Pewee (8.86%), Cliff Swallow (41.% of stomach contents), Parula and Black & White Warblers, Honey Creeper (1.55%).

SCOLYTIDÆ.

Stephanoderes opacifrons Hopkins
Leng & Mutchler 17–219.

Xyleborus affinis Eichhoff
Leng & Mutchler.

Xyleborus amphicollis Eichhoff
Leng & Mutchler.

Xyleborus confusus Eichhoff
Leng & Mutchler.
abundant under bark of dead bucare tree, *Erythrina glauca*, at Cayey (349–22 det. Hopkins); from coconut palm at Cabo Rojo (49–23 det. Hopkins), at San Lorenzo (10–21).

Xyleborus ferrugineus Fabricius
Gundlach, "viene por la noche a las luces de las casas."

Xyleborus inermis Eichhoff
Van Z. (P. R. 810).
Wetmore 16–87, 111: eaten by Cliff Swallow and Honey Creeper.

Xyleborus grenadensis Hopkins
Leng & Mutchler 17–220.

Xyleborus torquatus Eichhoff
Leng & Mutchler.

Xyleborus sacchari Hopkins
(as sp.) Van Dine 11–56; Van Dine 12–22; Van Dine 13–256; Van Dine 13–33; Smyth 19–142: all stages in rotten or dry sugar cane.
Leng & Mutchler 17–220.
all stages in rotten or dry stalks of sugar cane (900–14, 56–23 det. Hopkins), at Caguas (21–10), at Vega Alta (62–

10), at Barceloneta (26–10), at Añasco (42–10), at Guánica (237–11, 130–12, 526–14), at Patillas (168–12), at Humacao (48–13), at Mameyes (183–13); from *Inga vera* at Patillas (16–21 det. Hopkins).

Xyleborus spp.
Wetmore 16–87, 106, 108, 111: eaten by Cliff Swallow, Yellow and Parula Warblers, Honey Creeper.

STREPSIPTERA.

Stenocranophilus quadratus Pierce, W. Dwight, "Description of Two New Species of Strepsiptera (Halcotophagidae) Parasitic on Sugar Cane Insects", Proc. Ent. Soc. Wash., Vol. 16, No. 3, September, 1914, pp. 126–129.
reared from *Saccharosydne saccharivora* Westw. on sugar cane (847–12 TYPE and 974–13).

LEPIDOPTERA.

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The original records in the following list of Lepidoptera are based mainly on material determined by Dr. Harrison G. Dyar and Mr. Wm. Schaus, in the Sphingidae by Mr. B. Preston Clark, and in the Microlepidoptera by Mr. August Busck. Dr. Dyar has also described a number of new species from material collected by entomologists at the Insular Station. To Mr. Schaus, the writer is more especially indebted for indicating the order of listing of species, many generic transfers and synonymies in the Hesperidae and from the Noctuidae to the Microlepidoptera, and to Mr. Busck for the same services in the Microlepidoptera.

NYMPHALIDÆ.

Anosia plexippus Linnaeus
(as *Danaïs archippus* Fabr.) Dewitz. Stahl.
(as *Danaus erippus* Cramer) Möschler. Gundlach, "La oruga se cria en la *Asclepias curassavica.*"
Van Z. (2002) on *Asclepias* sp.
(158–12 det. Dyar), at Martin Peña (825–14), at Mameyes (339–92) on *Lantana* flowers; larvae on *Asclepias curassavica* (320–12), on the giant milkweed, *Calotropis procera,* at Yauco and Ponce (GNW).

Lycorea cleobaea Godart
Dewitz. Stahl. Möschler. Gundlach.

Heliconius charitonius Linnaeus
Dewitz. Stahl. Möschler. Gundlach, "Es notable por la costumbre que tienen todas las de una localidad de reunirse por la tarde y dormir una al lado de otra. La oruga se cría en especies del genero *Passiflora.*"
Van Z (P. R. 1429).

(as *Apostraphia*) AMNH, at Aibonito.
in clearings in the woods at Mameyes (801–12), at Martin Peña (25–14), at Quebradillas (EGS), at Arecibo (GNW).

Eueides cleobaea Hübner
Dewitz. Stahl. Möschler. Gundlach, "La oruga se cria en especies del genero *Passiflora*."

Colaenis delila Fabricius
Dewitz. Stahl. Möschler. Gundlach, "La oruga se cria en las *Passiflores*."

Colaenis julia Fabricius
Van Z. (P. R. 1419). AMNH at Aibonito and Mayagüez.
(666–12), at Martin Peña (23–14).

Dione vanillae Linnaeus
(as *Agraulis*) Dewitz. Stahl. Möschler. Gundlach, "La oruga se cría en las *Passifloras*."
Van Z. (P. R. 1427). AMNH at San Juan.
(884–14), larvae on *Passiflora* sp. (261–12, 700–16); adults at Mameyes on *Lantana* flowers (GNW).

Euptoieta hegesia Cramer
Dewitz. Stahl. Möschler. Gundlach, "La oruga se cría en la planta *Turnera ulmifolia*." AMNH at San Juan.
at Camuy (EGS), at Pt. Cangrejos (GNW).

Melitaea pelops Drury
Dewitz. Stahl. Möschler. Gundlach.

Phyciodes anocaona Herr. Sch.—det. Dyar.
on el Duque at Naguabo (730–14).

Synchloe tulita Gundlach
Dewitz. Stahl.
(as *Coatlantona*) Möschler. Gundlach, "cerca de la costa."
AMNH at Tallaboa.

Hypanartia paullus Fabricius
(as *Heurema*) Stahl.
(as *Euroma tecmesia* Hbn. or *Terias*) Dewitz.
Möschler. Gundlach.
Larvae on *Trema micranthum* at Ciales (495–21 adult det. Schaus) and in mountains north of Yauco (57–23). Head, either black, roughened with four kinds of cones; small black ones, medium-sized white or light-green ones, large light-green ones, darker at base and black at apex surrounding base of brown hair, and large black ones at top of head or, darker green than body, with no black cones, altho some of the largest are black at apex. On the eight anterior abdominal segments

are seven yellow, branched spines, often with apical half or two-thirds black or dark reddish-brown; four spines on the second and third thoracic and ninth abdominal; warts on the first thoracic. Body bright green below, with bluish-grey bloom above. Spiracles white with faint black margin. True legs opalescent reddish-brown. Prolegs covered with quite long white hairs.

Chrysalis, light green at first with whitish pubesence, later light bluish-grey; 6 golden spots dorsally, two on each of the anterior abdominal segments, with brownish prominences on those posterior along the median ridge. Two sharp horns on head; proboscis, legs, antennae and wing-veins outlined in darker green. Brown circle with yellow center anterior of the cremaster ventrally.

Pyrameis cardui Linnaeus
Dewitz. Stahl. Möschler. Gundlach.
at Cayey (GNW).

Junonia coenia Hübner
Van Z. (P. R. 138).
(658–12, 75–19).

Junonia lavinia Cramer
Dewitz. Stahl. Möschler. Gundlach, "Esta especie varía mucho; pero no es igual a la *J. coenia.*"
(887–14).

Junonia genoveva Cramer
Stahl. AMNH at San Juan.
(670–12), at Algarrobo (821–14); larvae on *Valerianoides jamaicensis* (692–16), on fog-fruit, *Lippia nodiflora*, at Pt. Cangrejos, in great abundance, March 1920 (GNW).

Larvae, black, spiny. Head shiny, deeply divided into two lobes, each with short spine. Body velvety, neck light chestnut in color, spines purplish, especially at base, the more ventral row short, yellow, black-tipped. Chrysalis, light and dark grey, spiny and elongate.

Anartia jatrophae Linnaeus
Dewitz. Stahl. Möschler. Gundlach. Van Z. (P. R. 139). AMNH.
(104–12), at Algarrobo (820–14); larvae on water hysop, *Bacopa monniera*, at Pt. Cangrejos, March 1920 (GNW).

Larvae black, spiny. Head shiny,, with two large branched spines. Body with silvery spots, more abundant dorsally, warts on first segment, large branching spines on others. Chrysalis short and plump, light green or opaque greenish-purplish-black, with bloom.

Eunica monima Cramer
Dewitz. Stahl. Möschler. Gundlach.
adults abundant, with *E. tatila* H. S., along irrigation ditch and road to Tablon No. 13, Hda. Santa Rita, Guánica (729–July 13 to 17, 1915).

Eunica tatila Herr. Sch.
Dewitz. Stahl. Möschler. Gundlach.
at Guánica (729–15).

Gynaecia dirce Linnaeus
Dewitz. Stahl. Möschler. Gundlach, "La oruga vive debajo de hoja de *Cecropia*, comiendo las nervaciones gruesas."
Van Z. (P. R. 140).

Didonis biblis Fabricius
(as *D. hyperia* Cr. & *Biblis thadana* Fabr.) Stahl.
Möschler. Gundlach. AMNH at Tallaboa.
at Quebradillas (EGS), at Arecibo (GNW).

Timetes chiron Fabricius
Dewitz. Stahl. (as *Megalura*) Möschler. Gundlach, "La oruga se cría en la *Maclura tinctoria* y acaso en el *Xanthoxylum*. El insecto suele posarse encima del fango para chupar."

Timetes petreus Cramer
(as *Marpesia*) Dewitz. Stahl.
(as *Megalura peleus* Sulzer) Möschler. Gundlach.
two adults, one yellowish, one reddish, at Guánica (728–15).

Anaea (Pyrrhanaea) morrisoni Edwards
Van Z. (P. R. 1434).

Anaea portia Fabricius
Van Z. (P. R. 1413).
at Guánica (727–15), resting on corn at Aguadilla (28–22), at Ponce (135–13); larvae of *Croton* at Ponce, Guánica and Boquerón (GNW).

(**Ageronia ferentina** Godart
Gundlach states specimens were collected by Dr. Stahl in Bayamón, and by Mr. Sentenis "en el interior de la parte oriental," but it is not mentioned in Stahl's list. As it is very common in Santo Domingo, the Porto Rican record is possibly due to accidental temporary introduction by commerce, or by migration.)

Victorina steneles Linnaeus
Dewitz. Stahl. Möschler. Gundlach. Van Z. (P. R. 1416).
in mountains at Añasco (1005–13), in coconut grove at Pt. Cangrejos (GNW); larvae on *Blechum brownei* in coffee grove at Lares (317–22).

Larval stage about twenty days. Fully-grown larva about 40 mm. long, 7 mm. broad. Head black, glistening, roughened with long black hairs, and two long black, knobbed and spined horns, 6 mm. long. Body velvety black, purplish or dark red at sutures, with four blackened spiny warts on first segment; four branched spines, orange-red or pink, on second and third segments; seven spines on each of the next seven segments, the more ventral ones shorter and all black, the next sometimes pink at base, the three dorsal rows always pink at base and arising from round orange spots, which are coalescent on the first three abdominal segments, but black-tipped, sometimes one-half or two-thirds black; eight spines on the eleventh segment and four arranged in a square on the final segment. True legs black and shiny, prolegs pinkish.

Chrysalis is 28 mm. × 10 mm., light green in color, covered with whitish bloom, head and wings transparent, suspended from a pinkish cushion of silk by black cremaster, 3.5 mm. long, black, divided at base. Two cephalic and one dorsal green horns, with slenderer black interior horns. Five pairs of pink spines on abdomen opposite the end of the wing-pads, besides twelve brighter pink spots anteriorily, and numerous smaller pink and black spots posteriorily. Pupal stage nine to ten days.

Hypolimnas misippus Linnaeus
Stahl. (as *Diadema bolina* Linn.) Dewitz.
(as *Diadema*) Möschler. Gundlach.
male collected by Alan York at Cayey, females at Boquerón (29–23).

Heterochroa gelania Godart
Möschler. Gundlach. (as *H. arecosa* Doubl. West.) Dewitz. Stahl.

Apatura idyja Hübner
Gundlach. (as *Doxocopa*) Stahl.

Historis orion Fabricius
(as *Aganisthos odius* Fabr.) Stahl. Gundlach, "La oruga se cría en la *Cecropia.*"
(as *Aganisthos*) Dewitz.
larva on *Cecropia peltata* (164–20, adult det. Schaus). "Flattish, medium-gray, with white saddle 5 by 10 mm. at middle of back and two prominent projections, with spiny protuberances projecting upward and outward from the head, about 3 mm. long. In the fully-grown caterpillar the saddle was greyer and less conspicuous. The pupa, reddish-brown in color, had two double-curved projections 4 to 5 mm. long extending forward from the head and almost touching at their apex, but 2 mm. apart at base." E. G. Smyth.

Historis acheronta Fabricius
(as *Megistanis cadmus* Cr.) Dewitz. Stahl. (as *M. acheronta* Fabr.) Möschler. (as *Aganisthos*) Gundlach.

Prepona antimache Hübner
(as *P. amphitoe* God.) Stahl. Dewitz. Möschler. Gundlach.

Paphia troglodyta Fabricius
Dewitz. Stahl. Möschler. Gundlach.

Siderone ide Hübner
Dewitz. Stahl. Möschler. Gundlach.

SATYRIDÆ.

Calisto nubila Lathy, P. I., "Monograph of the Genus *Calisto* Hübner." Trans. Ent. Soc. London. Part 2, June 1899, pp. 221–228, pl. 1. TYPE from Porto Rico.
(as *Calisto zangis* Fabr.) Dewitz. Stahl. AMNH at Aibonito.
(as *Callisto zangis* Fabr.) Möschler. Gundlach. Van Z. (P. R. 1419).
(668–12, 808–14, 885–14), at Trujillo Alto (895–13 det. Dyar), on El Duque, Naguabo (734–14), in mountains north of Yauco (296–21).

LIBYTHEIDÆ.

Libethea motya Hübner
Dewitz. Stahl. Möschler. Gundlach.

LYCÆNIDÆ.

Lycaena cassius Cramer
Dewitz. Stahl. Möschler. Gundlach.
at Camuy (EGS).

Lycaena hanno Hübner
Dewitz. Stahl. Möschler. Gundlach. Van Z. (P. R. 132).
at Algarrobo (813–14).

Lycaena marina Reakirt—det. Schaus
at Camuy (EGS).

Eupsyche telea Hewitson
Dyar –36.

Thecla acis Drury
Dewitz. Möschler. Gundlach.
at Ponce (137–13).

Thecla angelia Hewitson
Dewitz. Stahl. Möschler. Gundlach.

Thecla caelebs Herr. Sch.
Dewitz. Möschler. Gundlach, "La oruga come los botones de *Tetrapteris*."

Thecla cardus Hewitson
Dewitz. Stahl. Möschler. Gundlach.

Thecla cybira Hewitson
Dewitz. Möschler. Gundlach.

Thecla celida Hewitson
Dewitz. Möschler. Gundlach.

Thecla limenia Hewitson
Dewitz. Stahl. Möschler. Gundlach

Thecla maesites Herr. Sch.
Dewitz. Stahl. Möschler. Gundlach.

Thecla telea Hewitson
Dewitz. Stahl. Möschler. Gundlach.

Thecla simaethis Drury
Dewitz. Stahl. Möschler. Gundlach.

PIERIDÆ.

Leptalis (Dismorphia) spio Godart
Dewitz. Stahl. Möschler. Gundlach.
in coffee grove at Añasco (1006–13), on El Duque near Naguabo (736–14), common in August on El Yunque near Mameyes (EGS).

Pieris amarylis Fabricius
(as *P. josephina* God., var *krugii* Dewitz) Dewitz. Stahl. Möschler. Gundlach.

Pieris joppe Boisduval
Dewitz. Stahl. Möschler. Gundlach.

Pieris monuste Linnaeus
Dewitz. Stahl. Möschler. Gundlach, "Muy abundante y dañina, porque la oruga vive en las coles y otras plantas cruciferas."
Tower 08–35; on cabbage, raddish, turnip, kale and mustard.
Jones 15–6; on horse radish and *Cleome spinosa.*
Cotton 18–281; figures of egg, larvae and adult—on cabbage.
(760–12, 22–18); larvae on raddish (145–12, 80–19), on turnip (222–12), on cabbage (634–17, 657–17); on *Cleome spinosa* at Canóvanas (291–13), at Carolina (30–15); on *Gynandropsis pentaphylla* (499–12, 514–12).

Tachyris ilaire Godart
(as *T. margarita* Hbn.) Dewitz.
(as *Pieris*) Stahl.
(as *Daptonoura*) Möschler. Gundlach.
(as *T. margarita* Hbn.) Van Z. (P. R. 134).

Callidryas agarithe Boisduval
Dewitz. Stahl. Möschler. Gundlach
(as *Phoebis*) Van Z. (P. R. 1428).

Callidryas (Catopsilia) argante Fabricius
Dewitz. Stahl. Möschler. Gundlach.
at Camuy (EGS).

Callidryas (Catopsilia) eubule Linnaeus
Dewitz. Stahl. Möschler. Gundlach, "La oruga se cría principalmente en la *Cassia occidentalis.*"
Van Z. (P. R. 1423) on *Cassia* sp.
(598–12, 759–12, 667–12, 72–19); larvae on *Cassia occidentalis* (892–13, 740–14, 701–16, 88–20; on flowers of *Herpetica alata* at Guánica (GNW).

Callidryas neleis Boisduval
Dewitz. Stahl. Möschler. Gundlach.

Callidryas statira Cramer
(as *C. evadne* Bois.) Dewitz. Stahl.
Möschler. Gundlach, "La oruga se cría en las *Cassias.*"

Callidryas thalestris Hübner
Dewitz. Möschler. Gundlach, "La oruga se cría en varias especies de *Cassia* y en la *Poinciana.*"

Callidryas trite Linnaeus
Dewitz. Stahl. Möschler. Gundlach.

Callidryas rorata Butler—det. Schaus "a female aberration of *argante* Fabr."
larva on *Inga vera* at Cayey (33–21).

Kricogonia castalia Fabricius
(as *Gonepteryx*) Dewitz. (as *Rhodocera* (*G.*) *lycide* God.—*C.* Fabr.) Stahl.
Möschler. Gundlach, "Vive más bien cerca de la costa."

Anteos (Gonepteryx) clorinde Godart
Dewitz.

Anteos (Gonepteryx) maerula Fabricius
Dewitz. Möschler. Gundlach, "La oruga se cría en especies de *Cassia.*"

Terias citrina Poey
var. *portoricensis* Dewitz 77–237.
Möschler. Gundlach.

Terias elathea Cramer
(as *Eurema*) AMNH.

Terias euterpe Ménétries
Van Z. (P. R. 135). (as *Eurema*) AMNH.
(303–12, 258–17), at Algarrobo (812–14).

Terias jucunda Boisduval & Leconte
(as *T. ebriola* Poey) Dewitz. Stahl.
Möschler. Gundlach, "La oruga se encuentra sobre el *Desmodium.*"

Terias lisa Boisduval & Leconte = **T. sulphurina** Poey
Dewitz. Stahl. Möschler. Gundlach, "La oruga vive, según Boisduval, en la *Cassia* y *Glycine.*"

Terias palmira Poey
Dewitz. Stahl. Möschler. Gundlach, "Su oruga sobre el *Desmodium* "

PAPILIONIDÆ.

Papilio androgeus Cramer
Möschler Cotton 17–121; "Caterpillars—abundant in one (citrus grove)."
(as *P. polycaon* Cramer) Dewitz. Stahl. Gundlach, "Su oruga se cría en especies del género *Citrus.*"
Determined as var. *epidaurus* Godman & Salvin by Dr. Frank E. Watson.
larvae on citrus (931–16), at Manatí (806–16), at Lares (161–22).

Papilio cresphontinus Martyn
(as *P. aristodemus* Esper) Dewitz.
(as *P. daphnis* Martyn—*P. aristodemus* Esper) Stahl.
Möschler. Gundlach.

Papilio pelaus Fabricius
Dewitz. Stahl. Gundlach, "He cogido una crisálida fijada en el tronco de un *Xanthoxylum,* y probablemente la oruga se cría en esta mata."
at Martin Peña (24–14); twenty fully-grown larvae clustered on tree trunk of *Fagara (Xanthoxylum) martinicensis,* on web they had spun, unmoved by ant biting one or by a lizzard running over the group, at Cayey (345–22).
Fully-grown caterpillars are about 45 mm. long and 10 mm. broad at the thorax; head dull light yellow, very dark brown around the ocelli, numerous spots subtending hairs and the inverted Y creamy; general color of body purplish and greenish-brown (olive-drab), intricately marked with darker brown anteriorily, especially partly surrounding two dull yellow areas just posterior of the orange yellow osmateria, and posteriorly with numerous lighter markings like wisps of white smoke; large very irregular creamy spots on the sides of 5th, 6th and 7th (together) and 10th and 11th (together) segments—

body lighter colored beneath from 5th to 11th segments, with narrow whitish band connecting them just above the legs; two latero-dorsal warts on each segment, usually lighter colored and with a small lavender spot, irregular but sharply outlined, mediad of each wart, similar lavender spots occuring along the sides and below the spiracles, additional smaller lateral warts on the thorax; true legs dull light yellow, tipped and laterally marked with brown.

Papilio polydamus Linnaeus
Dewitz. Stahl. Möschler. Gundlach, "La oruga se cría en especies de *Aristolochia*. Exhala un olor a almiscle."
at Algarrobo (822–14).

Papilio nitra Edwards
Van Z. (One specimen recorded by Dr. Hooker, Mayagüez, July 14, 1912.)

HESPERIIDÆ.

Eudamus dorantes Stoll
(as *Goniurus*) Dewitz. Stahl.
(as *Goniuris*) Möschler. Gundlach.
Van Z. (P. R. 1433).

Eudamus proteus Linnaeus
(as *Goniurus*) Dewitz. Stahl. Möschler. (as *Goniuris*) Gundlach, "La oruga en papilionaceas (*Clitoria*)."
Van Z. (901) on beans.
Jones 15–7: on garden beans, cowpeas and *Phaseolus eathyroides*.
Cotton 18–277: notes, on beans.
(304-12, 671–12); larvæ on cowpeas (155–12), on beans (851–16, 132–22), on beggar weed, *Meibomia tortuosum* (871–14, 348–16), on *Stigmatophyllum ligulatum* at Loíza (131–23).

Goniurus talus Cramer
(as *Goniloba*) Dewitz. (as *Eudamus*) Möschler. Gundlach, "La oruga se cría en *Guarea trichilioides*."

Epargyreus zestos Hübner
(as *Goniloba*) Dewitz. Stahl.
(as *Aethilla*) Möschler. Gundlach.

Acolastus amyntas Fabricius
(as *Goniloba* or *Erycides*) Dewitz.
(as *Goniloba savignyi* Encycl.—*amyntas* Fab.) Stahl.
(as *Hesperia*) Möschler. Gundlach.
adults common at Boquerón (25–23 det. Schaus); larvae on *Ichthyomethia piscipula* at Boquerón and Pt. Cangrejos, have flat, heart-shaped heads, black in earlier instars, lemon yellow in final instar with a large black spot on each side of the dorsal cleft.

Proteides idas Cramer
(as *Goniloba*—var. *pedro*) Dewitz. (as *Goniloba*) Stahl.
(as *Eudamus*) Möschler. Gundlach.

Telegonus anaphus Cramer
(as *Goniloba*) Dewitz. Stahl.
(as *Aethilla*) Möschler. Gundlach.

Melanthes brunnea Herr. Sch.
(as *Nisoniades* & in synonymy with *Antigonus pterus* Cr.) Stahl.

Eantis thraso Hübner
(as *Achylodes*) Dewitz. Stahl. Möschler. Gundlach.
Van Z. (22) on orange. AMNH.
Cotton 17—21: "fairly common in some (citrus) groves."
larvæ on grapefruit leaves (9–20, 26–20), at Pt. Salinas (176–15), at Vega Alta (236–17); on wild orange at Aibonito (GNW), at Lares (405–22), in mountains north of Yauco (365–21); on *Zanthoxylum (Fagara) monophyllum* at Boquerón (26–23).

Head of larva, large, short, heart-shaped, in earlier instars reddish-brown, in last instar light greenish-brown, with darker mouth-parts. Body light yellowish-green with darker green narrow medio-dorsal stripe and broad lateral yellow bands made up of five irregularly rectangular spots on each segment. Neck and true legs yellow. Body in earlier instars is rounder and less tapering and with no indications of striping.

Chrysalis, green with whitish bloom, easily rubbed off, protruding eyes, held in a silken girdle and by cremaster in a slight cocoon in a rolled leaf. It becomes dark bluish-purple a day previous to the emergence of the adult.

Brachycorene arcas Drury
(as *Antigonus flyas* Cramer) Dewitz. Stahl.
(as *Antigonus*) Möschler. Gundlach, "La oruga se cría en aspecies de la familia de las apocíneas, v. g. del género *Echites*." With *Melanthes zepodea* Hübner, described from the female, in synonymy, as proved by rearing.

at Ponce (138–13), at Pt. Cangrejos (646–21); larvae on *Stigmatophyllum ligulatum* at Pt. Cangrejos (88–16, 629–21), at Loíza (132–23, a male and a female, *Melanthes zepodea* Hübner, reared from caterpillars identical in appearance), at Boquerón (27–23).

Larva, when fully grown, about 30 mm. long. Head, heart-shaped, short, broad ventrally, in earlier instars dark brown to piceous, roughly pitted subtending orange-colored hairs, with orange-colored markings: a large pair in front of the ocelli, a smaller pair behind, a dot above, a larger spot higher up and a broad band passing over the top of each side of the head; in last instar, light yellow in color with markings

of chrome yellow as in earlier instars of orange, mandibles and ocelli shining dark brown. Body light green, approximating in color the under-side of the leaves of the host plant, but darker in the middle and especially along the medio-dorsal line, nearly hemi-spherical in cross-section, and held closely appressed to the leaf. The body color is made up of a groundwork of grey-green, modified by numerous small bright yellow spots, which are confluent in two pairs of lateral lines, bounding the medio-dorsal line, and as latero-dorsal lines. Thoracic segments lighter in color, legs light yellowish-green, spiracles bright yellow.

Chrysalis 17 mm. × 5.5 mm. Shiny and glistening, with faint cocoon and well-developed girdle, but well concealed in folded leaf. Light apple green in color, especially on the dorsum of the abdomen, where the yellow spots and four lines of the larva persist, elsewhere greyer, more cloudy and somewhat opalescent; head blunt with sharp corners and covered with transparent hairs, curved at their ends; eyes opaque, white, sub-triangular, margined posteriorly with black; venation of wings showing as faint white lines.

Pyrgus syrichtus Fabricius
(as *P. orcus* Cr.) Dewitz. Stahl. Möschler. Gundlach, "La oruga se cría en malvaceas, v. g. *Sida*."
(as *Hesperia*) Van Z. (P. R. 131) AMNH.
at Naguabo on El Duque (737–14), at Algarrobo (815–14), at Quebradillas (EGS); larvae on *Sida carpinifolia* and *S. antillensis* (331–16, 368–16).

Pyrgus crisia Herr. Sch.
Dewitz. Möschler. Gundlach.

Nisoniades jaracco Lefebvre (in Lucas) = **N. juvenalis** Herr. Sch. Stahl.

Hylephilia phylaeus Drury
(as *Pamphila*) Dewitz.
(as *Hesperia*) Möschler. Gundlach.
Van Z. (P. R. 130). AMNH.
(156–12).

Atalopedes cunaxa Hewiston
(as *Pamphila mesogramma* Poey) Dewitz. Stahl.
(764–12 det. Schaus).
(as *Hesperia*) Möschler. Gundlach, "el nombre *alameda* Lefebvre es anterior a *cunaxa* Hewiston."

Thymelicus brettus Boisduval
(as *Goniloba coscina* Herr. Sch.) Stahl.
(as *Hesperia*) Gundlach.

Choranthus haitensis Skinner—det. Schaus.
(as poss. *C. ammonia* Plotz. det. Carl Heinrich) Wolcott 21-40: larva on sugar cane, life-history and description of stages.

Catia otho Abbott & Smith
(as *Pamphila* or *Oligoria*) Dewitz.
(as *Hesperia*) Möschler. Gundlach.
(as *Catia druryi* Latr.) AMNH.
(432-12), on El Duque at Naguabo (731-14, 732-14, 733-14), at Algarrobo (819-14 det. Schaus).

Atrytone vittelius Fabr.
(as *Pamphila*) Dewitz.
(as *Hesperia hubneri* Plotz.) Möschler. Gundlach.
Smyth 19-143: on sugar cane, Sudan grass and wild grasses.
Jones & Wolcott 22-42: on sugar cane, description of all stages.
larvae on sugar cane (29-14), (12-22), at Barceloneta (19-22), at Cayey (GNW).

Lerodea tripuncta Herr. Sch.
(as *Cobalus*) Dewitz. Stahl.
(as *Hesperia*) Möschler. Gundlach.
at Quebradillas (EGS det. Schaus).

Calpodes ethlius Cramer
Gundlach, "La oruga se alimenta de las hojas de Maranta y canna, y difiere por su forma, transparencia de la piel, y por la forma de la chrisalida de las otras especies antillanas."
Van Z. (1645) on *Canna coccinea.*
all stages on *Canna edulis* at Pt. Cangrejos, eggs being parasitized by *Trichogramma pretiosa* Riley (190-15); larvae on *Canna* (47-16, 865-16), a serious pest on the cannas at the Union Club, Santurce, (JDM), which had to be sprayed with Arsenate of Lead.

Prenes nero Fabricius
(as *Goniloba*) Dewitz.
(as *Hesperia*) Möschler. Gundlach.
(and as *Hesperia sylvicola* H. S.) Gundlach. Möschler.
(as *Goniloba sylvicola* H. S.) Dewitz. Stahl.
Van Z. (319) on sugar cane and grasses.
Van Dine 13-34; Van Dine 13-257; Jones 14-462; Smyth 19-143: on sugar cane.
Wolcott 21-38: notes, on sugar cane.
Jones & Wolcott 22-39: description of all stages and notes: larvae on sugar cane, rice, bamboo, malojillo, *Panicum barbinode*, grass and Johnson grass. Illustrations of larvae, pupa and adult.
(103-12); larvae on sugar cane (11-12, 5-13, 355-13, 979-13, 999-13, 1201-13, 1202-13, 9-14), at Luquillo (224-13), at Toa Alta (643-21); on *Panicum barbinode* (9-14).

Prenes ares Felder
Van Z. (320) on grasses and sugar cane.
Jones 14–462; Smyth 19–143: on sugar cane.
Wolcott 21–38: on sugar cane, notes.
Jones & Wolcott 22–41: description of all stages, notes, and illustrations of larva and pupa.
on El Duque at Naguabo (734–14); larvae on sugar cane (151–12, 25–13, 1216–13, 1217–13, 1218–13), on coarse grass (34–13), at La Plata (157–12).

Prenes ocola W. H. Edwards
AMNH.
at Algarrobo (817–14); larva on sugar cane (119–12), on *Hymenachne amplexicaule* (980–13).

Prenes parroquinoides Skinner
AMNH.

Cymaenes silius Latreille
(as *Pamphila*) Dewitz. Stahl.
(as *Hesperia*) Moschler. Gundlach.

Perichares corydon Fabricius
(as *Goniloba*) Dewitz. Stahl.
(as *Hesperia*) Möschler. Gundlach, "La oruga se cría en varias gramíneas de hojas no pequeñas, pues se esconde entre ellas reunidas con su seda, como todas las orugas de esta familia."
Van Z (308) on sugar cane.
Wolcott 21–40: on sugar cane.
Jones & Wolcott 22–28: on sugar cane.
(1–21); larvae on sugar cane at Arecibo (127–13), at Toa Alta (630–21, 645–21), at Guánica (18–22).

SPHINGIDÆ.

Determinations of Sphingidae in the Insular Station collection are by Mr. B. Preston Clark, or by the individual collectors, confirmed by Mr. Clark.

Herse cingulata Fabr.
(as *Sphinx*) Dewitz. Möschler. Gundlach.
(as *Macrosila*) Stahl.
(as *Phlegethontius convoluti* Linn.) Jones 15–7: on sweet-potato.
Van Z. (918) on sweet-potato.
(224–12, 120–21); larvae present in enormous abundance on sweet-potato along north-west coast of Porto Rico, between Arecibo and Aguadilla (110–December, 1918), many parasitized by Tachnid flies, *Belvosia bifasciata* Fabr. "Farmers at Hatillo say that about December 10th the larvae were seen by millions, and that after devouring all sweet potato vines in one field they migrated to another in hordes, crawling over one another 'in streams like ants.'" E. G. Smyth.

Oocytius antaeus antaeus Drury
(as *Amphonyx*) Dewitz. Stahl. Möschler. Gundlach, "La oruga se cría en *Anona muricata.*"
at light (147–12, 779–14, 571–16, 50–19), at Guánica (494–14); **parasitized larva on** *Anona* (43–19).

Oocytius cluentius Cramer
(as *Amphonyx*) Dewitz. Stahl. Möschler. Gundlach.
(one unlabeled specimen.)

Protoparce brontes Drury, var. **smythi** Clark, B. P., Proc. New England Zoological Club, Vol. 4, p. 100, pl. x, fig. 1, March 21, 1919, TYPE of variety from Porto Rico.
(as *Sphinx brontes* Dr.) Dewitz. Möschler. Gundlach.
(as *Macrosila*) Stahl.
at light (719–16 TYPE of variety, 1006–16).

Protoparce rustica rustica Fabricius
(as *Sphinx*) Dewitz. Möschler. Gundlach, "La oruga vive en *Sesamum* y en *Tecoma stans.*"
(as *Macrosila*) Stahl.
Van Z. (P. R. 1431).
at light (351–16).

Protoparce sexta Joh., var. **jamaicensis** Butler
(as *Macrosila carolina* Linn.) Dewitz. Stahl.
(as *Sphinx carolina* Linn.) Möschler. Gundlach, "Muy dañina al cultivo del tabaco, y en las huertas al tomate (*Lycopersicum*)."
(as *P. carolina* Linn.) Busck 00–89: on tobacco.
(as *P. carolina* Linn.) Barrett 03–448: economic notes.
(as *Phlegethontius*) Tower 08–36: eggs parasitized by *Telenomus monilicornis* Ashmead.
Van Z. (1101) on tobacco and tomato.
Jones 15–7: notes.
Cotton 18–310: notes.
Wolcott 22c–5: life history and control, illustrations of all stages and larva in beak of mozambique, *Holoquiscalus brachypterus.*
larvae on tomato (866–16); on *Solanum torvum* (181–12, 971–16), at Guánica (549–13); on tobacco at Aibonito (788–15), at Bayamón (16–19), at Arecibo (231–19), at Mayagüez (39–19).

(**Ceratomia amyntor** Geyer
Van Z. (P. R. 1432).)

Protambulyx strigilis Linn.
(as *Ambulyx*) Dewitz. Stahl. Möschler. Gundlach, "La oruga vive en *Comocladia* y también en *Erythroxylum.*"
at light, July and August (434–16, 559–16, 784–16, 817–16); **larvae (? of this species) on** *Anona muricata* (21–19, 112–19).

Pseudosphinx tetrio Linn.
Dewitz. Stahl. Möschler. Gundlach, "Oruga en *Plumería.*"
Busck 00–90: on *Plumieria rubra.*
Van Z. (1638) on *Plumeria.*
(264–16); larvae on *Plumiera alba* (134–20), very abundant at Ballena, on the coast by Guánica (725–15, 810–15).

Erinnyis alope Drury
(as *Anceryx*) Dewitz.
(as *Dilophonota*) Stahl. Möschler. Gundlach, "La oruga se cría en *Carica papaya.*"
Van Z. (P. R. 1430).
at light (436–16, 1013–16); larvae on host (45–16, 985–16, 122–21).

Erinnyis ello Linn.
(as *Anceryx*) Dewitz.
(as *Dilophonota*) Stahl. Möschler. Gundlach, "La oruga se cría en *Jatropha manihot.*" Notes on *Microgaster flaviventris* Cresson as a parasite of the larva.
Van Z. (1233) on *Carica papaya.*
at light (780–12, 1220–13, 321–16, 785–16); larvae on *Chamaesyce hyssopifolia* (781–14, 872–14, 1014–16); larvae on *Manihot utilissima* at Aguadilla (129–18).

Erinnyis crameri Schaus
at light (741–16).

Erinnyis domingonis Butler
at light (423–17).

Erinnyis merianae Grote
(as *Anceryx*) Dewitz.
(as *Dilophonota*) Möschler. Gundlach, "La oruga se cría en *Carica papaya.*"

Erinnyis oenotrus Cramer
(as *Anceryx*) Dewitz.
(as *Dilophonota*) Möschler. Gundlach. Stahl.

Erinnyis stheno Hübner
(as *Dilophonota*) Stahl. Möschler. Gundlach.

Isongnathus rimosa Grote, var. **wolcotti** Clark, B. P., Proc. New England Zool. Club, Vol. 8, p. 8, January, 1922, TYPE of variety from Porto Rico.
(as *Anceryx rimosa* Dr.) Dewitz.
(as *Dilophonota*) Möschler. Gundlach, "La oruga se cría en *Plumería.*"
(one unlabeled specimen, TYPE of the variety.)

Pachylia ficus Linn.
Dewitz. Möschler. Gundlach, "La oruga se cría en especies del género *Ficus.*"
Van Z. (P. R. 1422).
at light (1041–16, 16A–19), at Guánica (379–15, 714–15); larvae on *Ficus repens* (124–21), on *Castilloa elástica* (GNW); on *Ficus* sp. at Guánica (493–14).

Epistor lugubris Linn.
(as *Enyo*) Dewitz. Stahl. Möschler. Gundlach, "La oruga vive en varias especies de *Cissus* o *Vitis.*"
at light (511–12, 432–16, 72–21, 189–21).

Madoryx oiclus Cramer
pupating larva under rose bush at Río Grande (151–23).

Cautethia grotei Henry Edwards
(as *Oenosanda noctuiformis* Walker) Dewitz.
(as *Oenosanda*) Möschler. Gundlach.

Sesia tantalus Linn., var. **zonata** Drury
(as *Macroglossa*) Dewitz. Stahl. Möschler. Gundlach, "Se cría en plantas de la familia de las rubiaceas, v. g., *Genipa, Randia, Alibertina.*"
(one unlabeled specimen.)

Sesia aedon Boisduval
(as *Macroglossa*) Möschler. Gundlach.

Perigonia lusca Fabr., var. **interrupta** Walker
Dewitz. Möschler. Gundlach, "La oruga vive de *Genipa, Rondeletia, Gonzalea,* y otras rubiaceas."

Pholus labruscae Linn.
(as *Philampelus*) Dewitz. Stahl. Möschler. Gundlach, "La oruga se cría en especies del género *Vitis.*"
Van Z. (P. R. 1425).
at light (781–12, 558–16).

Pholus fasciatus Sulzer
(as *Philampelus*) Dewitz. Stahl. Möschler. Gundlach, "La oruga se cría en *Jussiaea.*"
Van Z. (P. R. 1426).
larvae on *Jussiaea* sp. (41–16), common at Martin Peña (152–23).

Pholus vitis vitis Linn.
(as *Philampelus*) Dewitz. Stahl. Möschler. Gundlach, "La oruga se cría en *Cissus (Vitis) sicyoides.*"
at light (433–16, 1077–16).

Xylophanes chironnechus Cramer
(as *Chorocampa nechus* Cr.) Dewitz. Stahl.
(as *Chorocampa chiron* Dr.) Möschler. Gundlach.
at light (61–16).

Xylophanes pluto Fabr.
(as *Pergesa thorates* Hübner) Dewitz. Möschler.
(as *P. pluto* Fabr.) Gundlach, "La oruga se cría en *Erythroxylum.*"
at light (782–12).

Xylophanes tersa Linn.
(as *Chorocampa*) Dewitz. Stahl. Möschler. Gundlach, "La oruga se cría en *Spermacoce.*"
Van Z. (P. R. 1415).
at light (12–12, 433–12, 435–16, 743–16, 23–19, 74–19); larvae on *Mitracarpus (Spermacoce) portoricensis* (768–16, 231–21); on *Diodia sarmentosa* at Mameyes (28–15).

Celerio lineata lineata Fabr.
(as *Deilephila*) Dewitz. Stahl.
(as *D. caucus* Fabr.) Möschler. Gundlach, "He cogido las orugas en *Oenothera* de los jardines, en *Claytonia perfoliata* y en *Boerhaavia.*"
Van Z. (P. R. 1424).
at light (783–12, at Guánica (1089–13).

AMATIDÆ (SYNTOMIDÆ)

Bombiliodes capistrana Fabr.
(as *Glaucopis selecta* Herr Sch.) Dewitz. Stahl. Möschler. Gundlach

Mallodeta partheni Fabr.
(as *Glaucopis multicincta* Walker) Dewitz.
(as *Poecilosoma multicincta* Walker) Möschler. Gundlach.
at light (197–12), at Vega Alta (113–17), at Guánica (633-13 det. Dyar.).

Eunomia insularis Grote
(as *Glaucopis*) Dewitz. Möschler. Gundlach, "La oruga en las convolvulaceas."
"*E. rubripunctata* Butler may be the species listed as *insularis* Grote, of which we have no specimens yet from Porto Rico." Wm. Schaus.

Nyridela chalciope Hübner
(as *Glaucopis*) Dewitz. Stahl.
(as *Isantherene*) Möschler. Gundlach, "La oruga se cría en la *Cupania americana.*"

Cosmosoma auge Linn.
(as *Glaucopis omphale* Hubner) Dewitz. Stahl.
(as *C. omphale* Hübner) Möschler. Gundlach, "La oruga se cría en la *Mikania.*"
Van Z. (P. R. 1401).
at light (144–16), at Arecibo (149–13), at Aibonito (SSC).

Cosmosoma achemon Fabr.
(as *Glaucopis tyrrhene* Hübner) Dewitz. Stahl.
at light at Arecibo (151–13 det. Schaus).

Lymire melanocephala Walker—det. Schaus.
(one unlabeled specimen.)

Lymire (Echeta) flavicollia Dewitz 77–94, TYPE from Porto Rico.
(as *Echeta*) Stahl. Möschler. Gundlach.

Lymire albipennis Herr. Sch.
(as *Echeta*) Dewitz. Stahl.

Horama panthalon Fabr.
Dewitz. Möschler. Gundlach.
abundant at Boquerón (31– Jan. 9, 1923).

Horama pretus Cramer
Dewitz. Stahl. Möschler. Gundlach.
Van Z. (P. R. 151).
at light (283–12), at Guánica (682–13); in coitu, feeding at flowers of *Tournefortia* sp. at Pt. Salinas (235–16); at flowers at Boquerón (30–23); larvae on *Elaeodendron xylocarpum* at Pt. Cangrejos (858–16), at Boquerón (111–23).

Fully-grown larvae are about 15 mm. long and 7 mm. wide, bright reddish-orange, reddest on thorax and head, shining. Body clothed with numerous spreading tufts of grey and white hairs, curved towards their tips. On the seven anterior abdominal segments dorsally are four compressed tufts of black hair in pairs, bending towards each other, the anterior pair of each segment closer together and touching at apex.

Cocoon of thin grey silk with the longer hairs from the larva entangled in it. Pupa bright reddish brown.

Empyreuma pugione Linn.
Dewitz. Stahl. Möschler. Gundlach, "Oruga en *Nerium.*"
(as *E. lichas* Cramer) Van Z. (1634) on oleander.
Van Zwaluwenburg 16–45: Eggs round, yellow — brown before hatching — slightly irridescent, finely sculptured, with dull sheen, regularly spaced in groups on under side of leaf. Larvae dull orange, hairy, with silvery lateral stripes. Larval stage 26 days, pupal stage 13 days. Adult has crimson wings and dark-blue body.

at light (107–16); larvae on oleander (91–21), at Arecibo (184–19).

Correbidia terminalis Walker
(as *Charidea cimicoides* Herr. Sch.) Dewitz. Stahl. Möschler. Gundlach, "La oruga - - - vive en la cara inferior de las hojas de *Cecropia,* formando luego un capullo poco primoroso."

Correbidia bicolor Herr. Sch.
(as *Charidea*) Möschler. Gundlach.

(**Charidea proxima** Grote
Dewitz. Möschler. Gundlach.)

Lycomorpha fumata Möschler 89–114, TYPE from Porto Rico.
Gundlach.

(**Orodesma apicina**
Stahl.)

LITHOSIIDÆ.

Progona (Delphyre) pallida Möschler 89–118, TYPE from Porto Rico.
Gundlach.

Agylla sericea Druce
(as *Gnophria limpida* Möschler) Möschler 89–117, TYPE from Porto Rico. Gundlach.

Paramulona albulata Herr. Sch.
(as *Mieza*) Dewitz. Stahl.

Cincia conspersa Walker.
Möschler. Gundlach, with *Mieza albulata* H. S. in synonymy.

Afrida tortriciformis Möschler
Möschler. Gundlach.

NOLIDÆ.

Nola (Stenola) bistriga Möschler 89–119, TYPE from Porto Rico.
Gundlach.

Celama sorghiella Riley
(as *Nola portoricensis* Möschler) Möschler 89–118, TYPE from Porto Rico. Gundlach.
larvae common in arrows of sugar cane (85–19, 382–22 det. Schaus).

ARCTIIDÆ.

Eupseudosoma involuta Sepp
(as *E. nivea* Herr. Sch.) Dewitz. Stahl. Möschler. Gundlach, "La oruga en *Psidium.*"
beautiful brown hairy larva on guava, *Psidium guajava,* (74–21), at Caguas (138A–16).

Ammalo insulata Walker
(as *Pareuchaetes cadaverosa* Cramer and *P. affinis* Grote, not in synonymy) Dewitz. Stahl. Möschler. Gundlach, "La oruga vive en *Vernonia, Eupatorium.*"
on weeds (889–14), on grass (307–16), at Aibonito (SSC); at light at Guánica (1061–13 det. Dr. Frank E. Watson); from pupa at Pt. Cangrejos (GNW).

Opharus (Halisidota) bimaculata Dewitz, 77–95, TYPE from Porto Rico.
Möschler. Gundlach.

Halisidota cinctipes Grote
Dewitz.
(as *H. tesselaris* Hübner) Möschler. Gundlach, "La oruga vive probablemente en *Hibiscus.*"

Ecpantheria icasia Cramer
(and as *E. eridane* Cr., not in synonymy) Dewitz. Stahl. Möschler. Gundlach.
(as *E. eridanus* Cramer) Van Z. (1630) on *Erythrina micropteryx*, *Ipomoea* sp., orange and banana. (Synonym of *E. icasia*—reared from same egg cluster and mated.)
Van Zwaluwenburg, R. H., "Notes on the Life History of *Ecpantheria eridanus* Cramer." *In* Insecutor Inscitiae Menstruus Vol. 4, Nos. 1–3, Jan.–March, 1916, pp. 12–17: an extended account, giving additional host plants as vanilla and *Cissus sicyoides*, description of all stages, life history and *Eremotylus angulatus* Hooker as a parasite of the larva.
Cotton 18–285: as a pest of celery, attacking the stalks.
at light (6–20); at Guánica (651–13); at Juncos (40–19); at Aibonito (SSC); pupa under loose bark on tamarind tree at Toa Baja (45–15); larvae on eggplant, bean, tomato (100–16), on *Erecthites hieracifolia* (818–16), on celery, injuring the stalks (62–17, 205–17), not on host (539–12); egg-cluster on *Psidium guajava*, from which 2,450 larvae hatched (13–17).

Calidota strigosa Walker
(as *Halisidota*) Dewitz. Stahl. Möschler. Gundlach.
(one unlabeled specimen.)

Utethesia bella Linnaeus and **U. ornatrix** Linnaeus
(as *Depiopeia*) Dewitz.
(and as *Callimorpha*) Stahl.
Möschler. Gundlach, "La oruga se cría en *Crotalaria.*"
(and as *U. venusta* Dalm. (P. R. 137)) Van Z. (2006) on *Crotalaria.*
(761–12, 738–14), at Mameyes (802–12), at light (367–12, 53–17), at Guánica (561–13); larvae on *Crotalaria retusa* (856–14, 44–15), at Isabela (433–21), at Guánica (701–14).

PHALÆNOIDIDÆ (AGARISTIDÆ).

Tuerta (Agarista) noctuiformis Möschler 84–112, TYPE from Porto Rico.
Gundlach.
(one unlabeled specimen—det. Schaus.)

NOCTUIDÆ.

Chloridea obsoleta Fabr.
(as *Heliothis armigera* Hübner) Stahl. Möschler. Gundlach, "En las mazorcas del maíz y en las cápsulas del algodón."
(as *Heliothis*) Barrett 03–443: attacking corn.
May 06–13: "only serious insect pest of corn."
Jones 15–7: mention.
Van Z. (906), on sugar cane.
Cotton 18–289: as a pest of corn.
Van Zwaluwenburg 15–35: attacking corn, tobacco buds and seed pods, and tomatoes.
Smyth 20–121: attacking corn.
at light at Guánica (668–13); larva in corn ear (223–12).

Chloridea virescens Fabr.
Möschler. Gundlach, "La oruga es muy dañina, principalmente al tabaco, pues vive en el cogollo y luego también en las cápsulas. Lo mismo en las cápsulas de *Hibiscus, Sesamum* y otras plantas. Una oruga que llevaba en la mano me mordía, y puesta con otras orugas se las comía."
Van Z. (1627) on *Cajanus cajan*.
larva on cotton at Sabana Grande (505–22).

Feltia annexa Treitschke
(as *Agrotis*) Stahl. Möschler. Gundlach, "La oruga vive durante el día al pie de plantas tiernas y sale al oscurecer para comer el tronco tierno Causa daño en las huertas."
Jones 15–8: mention. Wolcott 22c–12: as a pest of tobacco and methods of control, illustration of larva, the "cuerudo" of tobacco growers.
at light at Guánica (676–13 det. Watson); larvae on alfalfa at Fajardo (337–13 det. Dyar); larvae on tobacco at Cayey (73–21, 383–22, 8–23), at Caguas (150–21), at Corozal (Juan López), at Manatí and at Hatillo (GNW).

Rhynchagrotis ormalis Grote, var. **fecula** Grote
Dewitz.

Agrotis repleta Walker—det. Dyar
larva on sugar cane (150–12).

Agrotis submucosa Herr. Sch.
Möschler. Gundlach.

Agrotis apicalis Herr. Sch.
Möschler. Gundlach.

Lycophotia infecta Ochsenheimer
(as *Agrotis incivis* Guence) Möschler. Gundlach.
Van Z. (1509) on millet, grass, seed cane.
at light at Guánica (629–13 det. Dyar); pupa in tobacco field at Cayey (346–22 det. Schaus).

Miselia parvula Herr. Sch.
(as *Mamestra*) Möschler. Stahl. Gundlach.
at light (1009–16); larvae on *Solanum nigrum* (310–16, 373–16), at Isabela (503–18).

Tiracola plagiata Walker
(as *Agrotis grandirena* Herr. Sch.) Möschler. Gundlach.

Xanthopastis timais Cramer
(as *Euthisanotia*) Stahl. Möschler. Gundlach, "La oruga se alimenta de las hojas y cebellas de amarilideas."
Van Z. (1624) on *Hibiscus rosa-sinensis* and *Xanthosoma* sp.
larvae on the White Spider Amaryllis, *Hymenocallis expansa*, (54–16, 132–16), at Pt. Salinas (185–15). A common pest of this plant along the beach of the north coast.

Cirphis clarescens Herr. Sch.
(as *Leucania*) Möschler. Gundlach.

Cirphis secta Herr. Sch.
Stahl. (as *Leucania commoides* Guenee) Möschler.
(as *Leucania*) Gundlach.

Cirphis latiuscula Herr. Sch.
(as *Leucania*) Stahl. (as also as *L. punctifera* Möschler and as *L. senescens* Möschler, 89–142, TYPE from Porto Rico, not in synonymy) Möschler. Gundlach.
Van Z. (2010) on sugar cane, grasses.
Van Dine 13–257; Van Dine 13–33; Jones 14–462; Smyth 19–144: on sugar cane. Jones & Wolcott 22–43: description of larva and adult, larva feeds on older leaves of sugar cane and is parasitized by *Apanteles marginiventris* Cresson, *Euplectrus* sp., and a Tachind fly, *Compsilura oppugnator* Walton.
abundant at light at Guánica (638–13); larvae on sugar cane (224–11, 50–12, 101–12, 673–12, 37–13, 1219–13), at Toa Baja (29–15), at Vega Alta (189–13), at Mayagüez (79–19), at Santa Isabel (466–13).

Cirphis unipuncta Haworth
(as *Leucania extranea* Guenee) Stahl. Möschler. Gundlach.
at light at Guánica (667–13); larvae on grass at Cayey (191–12).

Cirphis inconspicua Herr. Sch.
(as *Leucania*) Stahl. Möschler. Gundlach.

(**Cirphis phragmitidicola** Guenee
(as *Leucania*) Möschler. Gundlach.)

(**Heliophila rimosa** Grote
Dewitz.)

Magusa orbifera Walker
(as *Laphygma angustipennis* Möschler) Möschler. Gundlach.

Cobaliodes tripunctus Hübner
Dewitz 77–243.

Perigea apameoides Guenee—det. Watson
at light at Guánica (1064–13).

Perigea cupentia Cramer
(as *Craniophora*) Möschler. Gundlach.
(as *P. infelix* Guenee) Stahl.
larva on *Pluchea purpurescens* (811–16 det. Schaus).

(**Perigera stelligera** Guenee
Möschler. Gundlach.)
"Wrongly identified by Möschler." Schaus

(**Perigera subaurea** Guenee
Stahl. Möschler. Gundlach.)
"Wrongly identified I think." Schaus.

Perigera albigera Guenee
Möschler. Gundlach.

Perigea concisa Walker—det. Watson
at light at Guánica (1064–13).

Perigea circula Guenee
Stahl. Möschler. Gundlach.
(One unlabeled specimen — det. Schaus.)

Perigea sutor Guenee—det. Watson
larvae on *Pluchea purpurescens* (790–16).

Perigea punctirena Walker
(as *Hadena*) Möschler. Gundlach.

Eriopus floridensis Guenee
(as *E. elegantulus* Herr. Sch.) Möschler. Gundlach, "Criado en *Aspidium*."
larva on fern (276–22 det. Schaus).

Eriopus jamaicensis Möschler
Möschler. Gundlach.

Agripodes jucundella Dyar, H. G., Insecutor Inscitiae Menstruus Vol. 10, No. 10, 1922, TYPE from Porto Rico.
larva on lichen on trees in mountains north of Yauco (338-21 TYPE) is grey-green and dark-brown to resemble the lichen, and forms a thin, tough cocoon in the lichens. The moth has the fore-wings light green, marked with black and white, hind-wings grey. Collected by Francisco Seín Jr.

Polyphaenis nona Möschler 89-131, TYPE from Porto Rico. Gundlach.

Cephalospargeta elongata Möschler 89-120, TYPE from Porto Rico. Gundlach.
at light at Guánica (644-13 det. Dyar).

Prorachia daria Druce—det. Dyar
at light at Guánica (653-13).

Catabena esula Druce—det. Schaus.
(One unlabeled specimen.)

Catabena vitrina Walker—det. Schaus.
(as *Callierges divisa* Herr. Sch.) Möschler. Gundlach.
(One unlabeled specimen.)

Callierges recondita Möschler 89-140, TYPE from Porto Rico. Gundlach.

Laphygma frugiperda Smith & Abbot
Stahl. Möschler. Gundlach, "La oruga daña a veces las siembras de maíz, caña y otras."
Van Z. (912) on sugar cane in seed beds, on *Panicum* sp.
Van Dine 13-31; Van Dine 13-257; Jones 14-462; Smyth 19-143: on sugar cane.
Jones, Thos. H., "Some Notes on *Laphygma frugiperda* S. & A. in Porto Rico" *in* Jour. Ec. Ent., Vol. 6, No. 2, April 1913, pp. 230-236.
Jones 15-7: on corn and onions, attacked by three Tachind parasites, one hymenopterous, three predators and two fungi.
Johnston 15-18: and Stevenson 18-207: host of *Botrytis rileyi* Farl. at Río Piedras and Guánica
Cotton 18-288: on corn, native grasses, fruit of tomatoes and green pods of beans.
Wolcott 21-38: on sugar cane, malojillo grass and corn.
Jones & Wolcott 22-45 to 49: the most complete account, with illustrations of all stages from Walton & Luginbill.
at light at Guánica (67-19); larvae on sugar cane (161-12, 196-12, 216-12, 251-12), at Arecibo (176-11), at Ponce (736-12), at Mameyes (790-12), at Arroyo (938-13); eggs on sugar cane (345-12), at Guánica (128-13); larvae on corn

(28–12, 217–12, 552–12, 635–17), at Moca (114–23); larvae on malojillo grass, *Panicum barbinode*, (23–12, 601–16, 637–16), at Mameyes (790–12); larvae on grass, *Eriochloa subglabra* (317–16), on meadow grass (151–21); on gramma grass, *Stenotaphrum secundatum* in a pasture at Hatillo (223–21); on rice (623–17); on alfalfa at Fajardo (336–13); eggs on *Phaseolus lathyroides* (which the larvae ate) at Canóvanas (125–13); larvae on banana (18–19), on eggplant (140–17); on cotton at Sabana Grande (550–21); eggs on post at Guánica (128–13).

Prodenia dolichos Fabr.
(as *P. commelina* S. & A.) Möschler. Gundlach.

Prodenia pulchella Herr. Sch.
Möschler. Gundlach.

Prodenia ornithogalli Guenee
(as *P. eudiopta* Guenee) Möschler. Gundlach.
Jones 15–8: on *Convolvulus.*
Wolcott 22c–13: larva attacking tobacco, illustration, known as "mantequilla" by tobacco-growers in Cuba.
at light at Guánica (665–13 det. Watson); larvae on eggplant (85–16), on rose (812–16), on fruit of tomato and pepper (543-16, 47-18); on tobacco at Cayey and Hatillo (67–23).

Prodenia latifascia Walker
(as *P. androgea* Cramer) Stahl. Möschler. Gundlach, "La oruga vive durante el día al pie de una planta tierna y de noche sale de la tierra a comer. Hace mucho daño en las huertas y otras tierras cultivadas, pues troncha los renuevos. Come de muy diferentes plantas."
Van Z. (912) on tomato.
(unlabeled specimens — det. Schaus); larva on tobacco at Caguas (166–21).

Prodenia testaceoides Guenee
Möschler. Gundlach.

Xylomiges eridania Cramer
(as *Callierges*) Stahl. Möschler. Gundlach, "La oruga en *Amaranthus* y en *Solanum torvum.*"
Jones 15–8: on *Amaranthus* sp.
(as *X. sunia* Guenee) Cotton 18–313: on tomato.
at light at Guánica (618–13); larvae on *Amaranthus spinosus* (177–11 det. Dyar), and also on *Solanum torvum* (52–12, 318–16, 349–16, 356–16, 602–16), on mulberry (117–23 det. Schaus); on *Amaranthus* at Guánica (505–13); on tomato (174–16).

Xylomiges sunia Guenee
(as *Callierges*) Möschler. Gundlach, "La oruga se cría en *Gossypium.*"
Van Z. (P. R. 1443).
Cotton 18–287: as a pest of chard and other vegetables, description of stages, life history and control.
at light at Guánica (618–13 det. Dyar); larvae attacking alfalfa at Fajardo (387–13 det. Dyar); on Swiss chard (552–17, 588–17, 632–17), on green peas (552–17), on celery (595–17, 618–17), on asparagus (68–19); pupa (199–12).

Galgula partita Guenee
Möschler. Gundlach.

Monodes deltoides Möschler
Möschler. Gundlach.

Monodes nucicolora Guenee
Möschler. Gundlach.
at light at Guánica (684–13 det. Watson).

Monodes arna Möschler nec. Guenee
(as *Hadena*) Möschler. Gundlach.
(and as *Hadena chalcedonia* Hübner) Möschler. Gundlach.
at light at Guánica (635–13 det. Schaus).

Monodes (Hadena) ligata Möschler 89–130, TYPE from Porto Rico. Gundlach.

Monodes (Caradrina) promiscua Möschler 89–142, TYPE from Porto Rico.
(One unlabeled specimen — det. Schaus.)

Bagisara subusta Hübner
(as *Atethmia inusta* Guenee) Stahl. Möschler. Gundlach.
at light (8–19), at Guánica (685–13 det. Watson and Schaus); on "salcilla", *Morongia leptoclada*, the probable host of the larva. E. G. Smyth.

Caularis undulans Walker
(as *Eudryas bartholomaei* Boisduval) Möschler. Gundlach.
rare at light at Guánica (649–13 det. Schaus).

Cydosia submutata Walker
(as *C. nobilitella* Cramer) Dewitz 77–95. Stahl. Möschler. Gundlach.
Van Z. (P. R. 1439).
at light (755–16), at Guánica (605–13 det. Dyar); in cane field at Mameyes (800–12); resting on eggplant (280–16); "believed to feed on *Solanum* sp." E. G. Smyth.

Eublemma cinnamomea Herr. Sch.
(as *Thalpochares*) Möschler. Gundlach.

Eublemma obliqualis Fabr.
(as *Thalpochares pallescens* Herr. Sch.) Möschler. Gundlach.

Cobubatha quadrifera Zeller
(as *Thalpochares grapholithoides* Möschler 89–167, TYPE from Porto Rico) Gundlach.

Ommatocheila mundula Zeller
(as *Thalpochares*) Möschler. Gundlach.

Lithacodia apicosa Haworth
(as *Erastria nigritula* Guenee) Stahl.
(as *Erastria*) Möschler. Gundlach.

Amyna octo Guenee
(as *Mesostrota stigmatula* Snell) Möschler. Gundlach.
at light at Guánica (673–13 det. Schaus).

Amyna bullula Grote
(as *Mesostrota imprimata* Möschler 89–163, TYPE from Porto Rico) Gundlach.

Xanthoptera botyoides Guenee
Stahl. Möschler. Gundlach.

Xanthoptera aurifera Walker
(as *X. tripuncta* Möschler 89–158, TYPE from Porto Rico) Gundlach.

Anateinoma affabilis Möschler 89–167, fig. 14, TYPE from Porto Rico.
Gundlach.

Helicontia pantherulia Herr. Sch.
(as *Emmelia uncinula* Herr. Sch.) Stahl. Möschler. Gundlach.
(One unlabeled specimen — det. Schaus.)

Helicontia margana Fabr.
(as *Emmelia variegata* Möschler 89–156, TYPE from Porto Rico, var. *ochracea* Möschler 89–156, TYPE of variety from Porto Rico) Gundlach.
(One unlabeled specimen — det. Schaus.)

Helicontia perstructana Walker
(as *Emmelia felina* Herr. Sch. and as *E. trigidula* Herr. Sch.) Stahl. Möschler. Gundlach.

Spragueia dama Guenee
(as *Emmelia*) Möschler. Gundlach.
at light at Guánica (620–13 det. Dyar).

Thalpochares albipectus Möschler 89–167, TYPE from Porto Rico.
Gundlach.

Thalpochares basalis Möschler 89–169, TYPE from Porto Rico.
Gundlach.

Thalpochares putnami Möschler 89–168, TYPE from Porto Rico.
Gundlach.

Oecharismena cara Möschler 89–166, TYPE from Porto Rico.
Gundlach.

Oecharismena nectarea Möschler 89–165, TYPE from Porto Rico.
Gundlach.

Krugia operta Möschler 89–164, TYPE from Porto Rico.
Gundlach.

Haplostola aphelioides Möschler 89–163, TYPE from Porto Rico.
Gundlach.

Metaponpneumata rogenhoferi Möschler 89–159, TYPE from Porto Rico.
Gundlach.

Erastria minima Herr. Sch.
Möschler. Gundlach.

Graeperia costalis Walker—det. Schaus.
(One unlabeled specimen.)

Tarachidia (Acontia) mixta Möschler 89–162, TYPE from Porto Rico.
(as *Acontia*) Gundlach.

Tarachidia semiflava Guenee—det. Schaus.
(One unlabeled specimen.)

Tarachidia (Hadena) disgrega Möschler 89–128, TYPE from Porto Rico.
(as *Hadena*) Gundlach.
very abundant at light at Guánica (584–13, determination and generic transfer by Mr. Schaus).

Eutelia blandula Herr. Sch.
(as *Eurhipia*) Möschler. Gundlach.

Eutelia ablatrix Guenee
(as *Penicillaria*) Möschler. Gundlach.

Eutelia (Penicillaria) cuprea Möschler 89–179, TYPE from Porto Rico.
(as *Penicillaria*) Gundlach.

Paectes devincta Walker
(as *Ingura vittata* Möschler 89–171, TYPE from Porto Rico) Gundlach, "Solamente conocida de Puerto Rico."

Paectes arcigera Guenee
(as *Ingura*) Stahl. Möschler. Gundlach.

Paectes obrotunda Guenee
(as *Ingura elegans* Möschler 89–170, TYPE from Porto Rico) Gundlach.
at light at Guánica (634–13 det. Schaus).

Stictoptera vitrea Guenee
Stahl. Möschler. Gundlach.

Stictoptera penicillum Herr. Sch.
Stahl. Möschler. Gundlach, "La oruga vive en *Parksonia aculeata* y en *Pospgigia procera.*"

Charcoma nilotica Rogenh.
(as *Paraxia chamaelon* Möschler 89–121, TYPE from Porto Rico) Gundlach.
at light at Guánica (608–13 det. Dyar); larvae, semi-transparent greenish-white, feeding on buds and webbing together small leaves of "sauce," Humbolt's willow, at Aguadilla (23–22 det. Schaus).

Leianophera transfossa Möschler 89–136, fig. 16, TYPE from Porto Rico.
Gundlach.

Casandria abseuzalis Walker
(as *Pleurasympieza smithii* Möschler 89–147, fig. 18, TYPE from Porto Rico) Gundlach.
one adult at light at Guánica (610–13 det. Dyar).

Casandria elota Möschler 89–145 (as **Collomena**), TYPE from Porto Rico.
(as *Collomena*) Gundlach.

Iscadia aperta Walker
(as *Encalypta schildei* Möschler 89–148, TYPE from Porto Rico) Gundlach.

Achaea ablunaris Guenee
(as *Ophisma ablunaris* Guenee, var. *hilaris* Möschler 89–202, TYPE from Porto Rico) Gundlach. Stahl.

Ophisma tropicalis Guenee
Stahl. Möschler. Gundlach, "Oruga en *Cupania.*"

Mocis marcida Guenee—det. Schaus.
A black spot nearly 1 mm. in diameter on inner margin of forewings, near base.
at light (196–11, 1016–16 det. Schaus); larvae feeding on cowpeas (52–21).

Mocis megas Guenee

The black spot very small or absent.

(as *Remigia*) Stahl. Möschler. Gundlach.

at light (54–17), at Mameyes (192–13 det. Dyar), at Guánica (563–13).

Mocis repanda Fabr.

(as *Remigia latipes* Guenee) Stahl.

(as *R. latipes* Guen. and as *R. repanda* Fabr., not in synonymy) Möschler. Gundlach.

(as *Remigia*) Van Z. (1507) on millet and grasses.

(as *Remigia*) Jones 13–230 to 236: with *Laphygma frugiperda* S. & A. attacking young sugar cane and malojillo grass, *Panicum barbinode,* at Río Piedras, Mameyes and Cayey, La Plata.

(as *Remigia*) Van Dine 13–257; Van Dine 13–31; Jones 14–462: as a pest of sugar cane, larvae feeding on the leaves.

Smyth 19–144: on sugar cane and grasses.

Wolcott 21–38: larvae parasitized by *Euplectrus* sp. at Morovis.

Jones & Wolcott 22–49: the most complete account, description of all stages and parasites noted: *Phorocera claripennis* Macq., *Linnaemyia fulvicauda* Walton, *Helicobia helicis* Towns., *Chalcis* near *robusta* Cress. (*C. robustella* Wolc.) and *Rogas* sp. attacking the larvae, and *Sarcophaga sternodontis* Towns. reared from the pupa.

at light (1124–16, 82–19, 90–21), at Guánica — very common — (606–13); pupa in *Ipomoea* leaf (148–12); larvae on sugar cane (24–12), at Mameyes (811-12, 841–12), at Guayama (202–12), at Santa Isabel (209–11), at Fortuna (31–12), at Guánica (659–14, 24–15), at Barceloneta (E. D. Colón, Nov. 1922); on malojillo grass, *Panicum barbinode,* (24–12), at Arecibo (160–19); in pasture at Cabo Rojo (437–21).

Phurys immunis Guenee

Stahl. Möschler. Gundlach.

(One unlabeled specimen — det. Schaus.)

Phurys helvina Guenee

Stahl. (as *P. helveola* Herr. Sch.) Möschler. Gundlach.

Nymbis garnoti Guenee

(as *Phurys*) Stahl. Möschler. Gundlach.

Safia acharia Cramer

(as *Yrias*) Möschler. Gundlach.

Zale setipes Guenee

(as *Xylis*) Stahl. Möschler. Gundlach.

Zale exhausta Guenee

(as *Homoptera*) Möschler. Gundlach.

Zale fictilis Guenee
(as *Homoptera*) Möschler. Gundlach.
at light (944–16 det. Schaus).

Zale lunata Drury
(as *Homoptera*) Möschler. Gundlach.

Zale terrosa Guenee—det. Schaus.
at light (944–16).

Zale obsita Guenee
(as *Homoptera*) Stahl.

Decalea infusa Walker
Möschler. Gundlach.

Syngrapha egena Guenee—det. Schaus.
larva on shade tobacco at Cayey (7–23).

Syngrapha egenella Herr. Sch.
(as *Plusia*) Möschler. Gundlach.

Phytometra verruca Fabr.
(as *Plusia*) Möschler. Gundlach.
larvae on purslane (149–12), on *Hyptis capitata* (363–16 det. Schaus 315–16, 987–16).

Phytometra ni Hübner
at light at Guánica (650–13 det. Schaus).

Phytometra calceolaris Walker
(as *Plusia*) Möschler. Gundlach, "La oruga en *Commelyna*."

Phytometra oo Cramer
(as *Plusia binotula* Herr. Sch.) Stahl.
(as *Plusia rogationis* Guenee) Stahl. Möschler. Gundlach. Cotton 18–311: as a pest on tomato, notes and control. Wolcott 22c–14: a pest on tobacco and tomato, notes and control, "el Argrimensor Verde".
at light (937–16, 582–17), at Vega Baja (497–16), at Guánica (681–13); larvae on tomato (175–16, 1–16, 117–22); on tobacco at Cayey (327–17); on beans (608–17), on sweet potatoes (122–17).

QUADRIFINAE.

Erebus odora Linn.
Stahl. Möschler. Gundlach, "La oruga se alimenta de varias especies de *Cassia*, de *Pithecolobium* etc., ocultándose durante el día entre las grietas de la corteza." Van Z. (1418) on *Cassia fistula*, *Pithecolobium saman* and *Ficus* sp.
adults found in the laboratory in the morning (747–13, 981–13, 570–16, 539–19).

Letis atricolor Guenee
Möschler. Gundlach.

Letis mycerina Fabr.—det. Schaus.
Wolcott 23–57: larva feeding on leaves of coffee.
in coffee grove at Adjuntas (486–21, 283–22), flying about in the dusk, snapping their wings together occassionally or struggling to copulate on the ground, at Ciales (462–21); larvae on coffee at Lares (425–21).

Latebraria amphipyroides Guenee
Möschler. Gundlach, "Oruga en especies de *Cassia*."

Peosina numeria Drury
Stahl. Möschler. Gundlach.

Brujas rengus Poey
Möschler. Gundlach.

Concana mundissima Walker
(as *Theliodora splendens* Möschler) Möschler. Gundlach.

Eulepidotis addens Walker—det. Dyar
a small green leaf-folding caterpillar on *Inga vera* at Cayey (36–21).

Eulepidotis superior Guenee
(as *Palinda dewitzii* Möschler 89–196, TYPE from Porto Rico)
(as *Palinda*) Gundlach.

Eulepidotis mabis Guenee
(as *Palinda*) Möschler. Gundlach.

Eulepidotis hebe Möschler (as **Palinda**) 89–195, TYPE from Porto Rico.
(as *Palinda*) Gundlach.

Eulepidotis striaepuncta Herr. Sch.
(as *Palinda variabilis* Möschler, var. *obscura* Möschler 89–195, TYPE of variety from Porto Rico) Gundlach.

Eulepidotis rectimargo Guenee
Stahl.

Eulepidotis inferior Herr. Sch.
Stahl.

Eulepidotis modestula Herr. Sch.
(as *Palinda*) Möschler. Gundlach. Van Z. (P. R. 1406).
common at light at Guánica (625–13 det. Dyar).

Dyomyx juno Möschler 89–197, TYPE from Porto Rico.
Gundlach.

Noropsis hieroglyphica Cramer

(as *Euglyphia fastuosa* Guenee) Stahl.

(as *N. fastuosa* Guenee) Möschler. Gundlach, "Oruga en *Corchorus.*"

Van Z. (P. R. 1421). Van Zwaluwenburg 18–33: on *Waltheria americana* and *Morongia leptoclada.* "The larvae are more or less gregarious and drop to the ground when distributed. The full grown larva is about 25 mm. long and about 4 mm. across the head. The ground color of the body is bluish or greenish white with a black stripe running around the body on each segment. The segments are divided from one another by a narrow black line. The anal plate and head are reddish-brown, the collar shiny black. The oval pupa case, about 22 × 10 mm. is formed of parchment-like material on the stem of the food plant and is covered with grass and bits of leaves."

at light (612–12), very abundant at Guánica (550–13); reared from cocoon (162–12), very abundant on fence posts in cane fields at Yauco (330–21); larvae on *Waltheria americana* at Boquerón (16–23).

Pseudohemiceras krugii Möschler 89–176, TYPE from Porto Rico. Gundlach.

at light at Guánica (564–13 det. Dyar); larvae boring in twigs of roble, *Tecoma pentaphylla* (831–16).

Hemicephalis characteria Cramer

Möschler. Gundlach.

Melipotis fasciolaris Hübner

(as *Bolina*) Möschler. Gundlach.

at light at Guánica (677–13 det. Schaus).

Melipotis contorta Guenee

(as *Bolina striolaris* Herr. Sch.) Stahl. Möschler.

(as *Bolina*) Gundlach.

Melipotis ochrodes Guenee

(as *M. manipularis* Guenee) Van Z. (P. R. 1435).

common at light at Guánica (582–13 det. Dyar, 1060–13); pupa in crevice in leguminous tree at Fajardo (21–15); larvae in hole nearly covered with bark in leguminous tree at Central Mercedita (74–22); larvae in crevices in bark of algarroba trees (*Prosopis julifloria, P. glandulosa* and *P. pubescens*) or under trash at the base of trees at Guánica (412–14, 426–14, 452–14, 499–14).

Melipotis januaris Guenee

(as *Bolina* and as *B. russaris* Guenee, not in synonymy) Möschler. Gundlach, "Esta especie varía mucho, v. g. var. *limitata,* var. *bimaculata,* var. *confusa* Möschler."

Van Zwaluwenburg 18–34: Thousands of the larvae on guama, *Inga laurina,* at Mayagüez in June, 1917; pupated in the ground.

Melipotis rectifasciata Herr. Sch.
(as *Bolina*) Möschler. Gundlach.

Melipotis leucomelana Herr. Sch.
(as *Bolina*) Möschler. Gundlach.

Melipotis nigrescens Grote & Robinson, var. **ochreipennis** Harvey
(as *Bolina*) Möschler. Gundlach.

Melipotis acontioides Guenee = **sinualis** Harvey — det. Watson
at light at Guánica (1058–13).

Epidromia pannosa Guenee
(as *E. rotundata* Herr. Sch.) Stahl.
Möschler. Gundlach.

Thermesia gemmatilis Hübner
Stahl. Möschler. Gundlach.
(as *Anticarsia*) Cotton 18–293: larva destructive to velvet beans and cowpeas, notes and control.
at light (832–16), at Guánica (660–13); larvae on *Phaseolus max* (866–14, 876–14), on foliage of gallito trees, *Agati grandiflora* (974–16).

Thermesia elegantula Herr. Sch.
Möschler. Gundlach, "Es probable que esta y la especie precedente sean iguales." "A form of the preceeding." Schaus.

Pangrapta repugnalis Hübner
(as *Azeta*) Stahl. Möschler. Gundlach.

Bendis formularis Hübner
(as *B. impar* Guenee) Stahl.
Möschler. Gundlach, "La oruga se cría en *Cassia obtusifolia*."
at light (52–17), at Guánica (1065–13 det. Schaus).

Bendis magdalia Guenee
Möschler. Gundlach.

Aluaca flavicapilla Möschler (as **Diastema**) 89–162, TYPE from Porto Rico.
(as *Diastema*) Gundlach.
larvae on *Agati grandiflora* (205–12 det. Dyar as *A. agilaria* Druce).

Yrias progenies Guenee
Möschler. Gundlach. Van Z. (P. R. 1408).
at light at Guánica (603–13 det. Dyar).

(**Celaeno amoides** Herr. Sch.
Stahl.)

Toxonprucha diffundens Walker
(as *T. amoena* Möschler 89–198, fig. 1, TYPE from Porto Rico)
Gundlach.

Capnodes anhypa Guenee
Möschler. Gundlach.

Capnodes prisca Möschler 89–216, TYPE from Porto Rico.
Gundlach.

Capnodes sterope Cramer
Möschler. Gundlach.

Capnodes astyla Möschler 89–215, TYPE from Porto Rico.
Gundlach.

Capnodes priscilla Möschler 89–216, TYPE from Porto Rico.
Gundlach.

Capnodes turtur Felder & Rogenhf., var. **insularis** Möschler 89–215, TYPE of variety from Porto Rico.
Gundlach.

Selenis portoricensis Möschler 89–214, TYPE from Porto Rico.
Gundlach.
larva on *Aeschynomene sensitiva* (882–14 det. Schaus).

Selenis suero Cramer
(as *S. sueroides* Guenee) Stahl.
Möschler. Gundlach.
(One unlabeled specimen — det. Schaus.)

Orodesmia apicina Herr. Sch.
Stahl.

Baniana significans Walker
Möschler. Gundlach.
at light at Guánica (1067–13 det. Schaus).

Focilla angularis Möschler
Möschler. Gundlach.

Ephyrodes cacata Guenee
Möschler. Gundlach.

Syllectra ericata Cramer
Möschler. Gundlach.
(One unlabeled specimen — det. Dyar).

Syllectra lucifer Möschler 89–210, TYPE from Porto Rico.
Gundlach.

Syllectra congemmalis Hübner
(as *S. fictillina* Möschler) Möschler. Gundlach.

Parachabora abydas Herr. Sch.—det. Schaus.
at light at Guánica (674–13).

Alabama argillacea Hübner
(as *Anomis*) Stahl. Möschler. Gundlach
Van Z. (1401) on cotton.
Wetmore 16–119: eaten by Mozambique.
Barrett 06–23: "destructive in small areas (in 1905) throughout a large cotton plantation (near Aguadilla) – – – the pupae nearly all parasitized by *Chalcis annulata* Fabr."
May 06–11: "caused serious injury in a great many fields."
Smyth 20–122: an outbreak in the Hatillo district during July 1919.
Wolcott 23–59: not observed in 1921.
larvae on cotton in large numbers at Hatillo (510–19), during 1922 at Vega Baja (207– June, 1922), at Hatillo in August (206–22), very abundant in September in a few fields, had disappeared in October (329–22), at about the same time at Boquerón, a few parasitized pupae being found in January 1923 (23–23). The small larvae are killed by *Apanteles aletiae* Riley, the pupae by *Chalcis incerta* Cresson and *Sarcophaga sternodontis* Towns.

Anomis doctorium Dyar
(as *Alabama argillacea* Hübner on *Urena lobata*) Smyth 20–122: recommends the destruction of *Urena lobata* to eliminate the alternate host of the cotton caterpillar, but the moths he reared prove to be *Anomis doctorium* Dyar (694–16).
Wolcott 23–59: larvae on cotton.
larvae on cotton at Humacao (435–21), at Guayama (515–22), at Villalba (553–21), at Guánica (335–21, 434–21), at Camuy (226–21 det. Dyar), at Manatí (555–21), at Vega Baja and Garrochales (332–22); on *Urena lobata* (694–16); (on *Malachra rotundifolia* (969–16), no specimen in the collection and identification doubtful).

Anomis fulvida Guenee
Stahl. Möschler. Gundlach.

Anomis illita Guenee
Möschler. Gundlach.

Anomis praerupta Möschler 89–173, TYPE from Porto Rico.
Gundlach, "No está indicada de otras tierras."

Anomis editrix Guenee
Stahl. Möschler. Gundlach, "La oruga se cría en *Triumfetta*."
larvae on *Triumphetta* sp. (800–16 det. Watson).

Cosmophila erosa Hübner
Stahl. Möschler. Gundlach. "La oruga se cría en *Plumbago*, también en las *Althea*."
resting on cotton at Sabana Grande (504–22), at light at Guánica (1084–13 determined by Dr. Watson and by Mr. Schaus).

Plusidonta thomae Guenee
Möschler. Gundlach.

Oraesia metallescens Guenee
Möschler. Gundlach.

Oraesia aequalis Walker
Möschler. Gundlach.

Pseudocalpe tristriga Herr. Sch.
Möschler. Gundlach.)

Gonodonta hesione Drury
Möschler. Gundlach.)

Gonodonta latimacula Guenee
Möschler Gundlach, "Oruga en *Artanthe* y *Potomorphe.*"

Gonodonta maria Guenee
Stahl. Möschler. Gundlach, "Oruga en *Anona glabra* y *palustris, Bocagea virgata, Nectandra.*"

Gonodonta nitidimacula Guenee—det. Dyar
larva feeding on leaves of unidentified tree (165–21, 174–21), on *Piper medium* (176–21), at Cayey (384–22) Larva is entirely velvety black, except for yellow clypeus, two bright yellow semi-circular spots on the sides of the first segment, two narrow reddish-orange spots on the fourth segment and two small yellow spots dorsally, two small reddish-orange spots on the sides of the seventh segment, four larger on the eighth, two large ones on the ninth and tenth and two small ones on the eleventh, all lateral, and two large crescents on the hump of the twelfth, dorsally. Adult has a white head and black eyes and a large yellow spot in the middle of each hind wing, elsewhere brown, the forewings variegated with purple.

Gonodonta soror Cramer
Stahl. Möschler. Gundlach.

Gonodonta uxoria Cramer
Stahl.

Gonodonta teretimacula Guenee
Stahl. Möschler Gundlach, "La oruga come *Artanthe.*"

Ophideres gubernatrix Guenee
Möschler. Gundlach.

Oocytodes schneideriana Cramer—det. Schaus.
at light (209–16).

Hybloea puera Cramer
Stahl. Möschler. Gundlach. Van Z. (P. R. 124).
at light (587–22); larvae feeding on leaves of roble trees, *Tecoma pentaphylla* (199–17 det Schaus), in great abundance at Guaynabo (586–22), at Comerío (388–22).

HYPENINAE.

Phiprosopus albigutta Herrick-Schaeffer—det. Schaus.

larvae abundant on undetermined host at Boquerón (110–23). Looper caterpillars, about 30 mm. long, grey in general appearance, due to irregular, waved, longitudinal, narrow stripes of yellow, or orange edged with yellow, alternating with broader stripes of greyish lavender margined with darker lavender. Two pairs of prominent yellow warts on the most elevated abdominal segments, covered with short fine brown hairs. Setae and their bases black. Head creamy and opalescent, with rows of aggregations of orange-yellow dots and dark brown ocelli, mouth-parts creamy and opalescent.

Cocoons of light yellow silk, thick and roughly quadrangular, 6 $\times$ 20 mm.

Adults with considerable variation, but with a diagonal stripe, creamcolored, or dark brown, from apical angle to about the middle of the inner margin of forewings constant.

Tortricodes orneodalis Guenee—det. Schaus.

at light at Guánica (679–13); larva on tomato (173–16).

Rivula pusilla Möschler 89–234, TYPE from Porto Rico. Gundlach.

Lophoditta tuberculata Herr. Sch.

(as *L. perspicillaris* Möschler 89–231, TYPE from Porto Rico) Gundlach.

Mastigophorus dimissalis Möschler 89–233, TYPE from Porto Rico. Gundlach.

Physula peckii Möschler 89–232, TYPE from Porto Rico. Gundlach.

Phlyctaina irrigualis Möschler 89–229, TYPE from Porto Rico. Gundlach.

Tetanolitha mutatalis Möschler (as **Scelescepon**) 89–230, TYPE from Porto Rico.

(as *Scelescepon*) Gundlach.

(One unlabeled specimen — det. Schaus).

Zagorista debora Druce—det. Schaus.

larvae on leaves of *Caperonia palustris* (379–16, 886–16).

Palinthis clanymoides Möschler (as **Lophophora**) 89–228, TYPE from Porto Rico.

(as *Lophophora*) Gundlach.

Bleptina caradrinalis Guenee

(as *B. subjecta* Möschler 89–226, TYPE from Porto Rico) Gundlach.

Bleptina acastusalis Walker
(as *Anagoa nigromaculalis* Möschler 89–218, and *A. placidalis* Möschler 89–219, TYPES from Porto Rico) Gundlach.

Bleptina menalcasalis Walker
(as *Anagoa limatalis* Möschler 89–218, TYPE from Porto Rico) Gundlach.

Aglaonice hirtipalpis Walker
(as *A. snelleni* Möschler 89–227, TYPE from Porto Rico) Gundlach.

Mursa gracilis Möschler (as **Sisputa**) 89–222, TYPE from Porto Rico.
(as *Sisputa*) Gundlach.

Hormoschista orba Grote
(as *H. pagenstecheri* Möschler 89–221, TYPE from Porto Rico) Gundlach.

Bomolocha exoletalis Guenee
(as *Hypena*) Möschler. Gundlach.

Bomolocha umbralis Smith
(as *Hypena cervinalis* Möschler 89–223, TYPE from Porto Rico) Gundlach.

Bomolocha conditalis Möschler (as **Hypena**) 89–222, TYPE from Porto Rico.
(as *Hypena*) Gundlach.
"probably the same as *vetustalis* Guenee." Schaus.

Anepischetos lividalis Hübner
(as *Hypena*) Möschler. Gundlach.

Anepischetos porrectalis Fabr.
(as *Hypena incertalis* Möschler 89–225, TYPE from Porto Rico) Gundlach.

Anepischetos degesalis Walker
(as *Hypena vinculalis* Möschler 89–224, TYPE from Porto Rico) Gundlach.

Carteris oculatalis Möschler (as **Zanclognatha**) 89–225, TYPE from Porto Rico.
(as *Zanclognatha*) Gundlach.

Metalla variabilis Möschler 89–220, TYPE from Porto Rico. Gundlach.

PERICOPIDÆ (HYPSIDÆ).

Lauron vinosa Drury
Dewitz. Stahl. Möschler. Gundlach, "La oruga en *Tournefortia* y *Heliotropium.*"
Van Z. (P. R. 123) on *Heliotropium indicum.*

Jones, Thos. H., "Some Notes on the Life History and Habits of *Lauron vinosa* Drury" *in* Insecutor Inscitiae Menstruus, Vol. 2, No. 7, 1914, pp. 108-111; description of all stages.
(26–12, 521–12, 953 to 958–13, 976–13, 977–13, 986–13, 989–13, 469–16).

Composia fidelissima Herr. Schaffer—det. Schaus.
at light at Arecibo (149–13); flying about in bright sunlight and feeding at *Lantana* flowers in opening in palm grove on the beach at Mameyes (337–22).

Composia subcyanea Walker—det. Dyar
on grass and weeds in abandoned coffee grove in mountains north of Yauco (246–22).

Composia sybaris Cramer
Dewitz. Stahl. Möschler. Gundlach.

NOTODONTIDÆ.

Nystalea ebalea Cramer
Möschler. Gundlach, "La oruga vive en *Comocladia* y en *Spondias.*"

Nystalea nyseus Cramer
(as *Cyrrhahesta*) Dewitz. Stahl.
Möschler. Gundlach.

Proelymiotis aequipars Walker
(as *Nystalea divisa* Möschler) Möschler. Gundlach.

Edema insularis Grote
Dewitz. Möschler. Gundlach, "La oruga se cría en *Cupania.*"

Rifargia distinguenda Walker
(as *Symmerista dubia* Möschler) Möschler. Gundlach.

EPIPLEMIDÆ.

Nedusia excavata Möschler 89–244, TYPE from Porto Rico.
Gundlach.

Syngria reticularis Möschler 89–256, TYPE from Porto Rico.
Gundlach.

Syngria ramosaria Möschler 89–256, TYPE from Porto Rico.
Gundlach.

Cerasympiasta marsitata Möschler 89–261, TYPE from Porto Rico.
Gundlach.

Cerasympiasta sanata Möschler 89–262, TYPE from Porto Rico.
Gundlach.

Erosia ineptaria Möschler 89–262, TYPE from Porto Rico.
Gundlach.

Erosia excludaria Möschler 89–262, TYPE from Porto Rico.
Gundlach.

Erosia obvallataria Möschler 89–263, TYPE from Porto Rico.
Gundlach.

GEOMETRIDÆ.

Phrygionis argentata Drury
(as *Eulepidotus*) Möschler. Gundlach.

Phrygionis cultaria Hübner
(as *Eulepidotus*) Stahl. (as *E. paradoxata* Guenee, determination doubtful) Möschler. Gundlach.

Phrygionis polita Cramer
Möschler. Gundlach.
"Probably all three species wrongly identified." Schaus.

Chrysocestis fimbriaria Cramer
Möschler. Gundlach.

Stegania subpusaria Herr. Sch.
Möschler. Gundlach.

Numia terebintharia Guenee
(and as *Numia buxaria* Guenee, not in synonymy) Möschler. Gundlach.

Syrrhoedia decrepitaria Hübner
(as *Acroleuca*) Stahl. Möschler. Gundlach

Casbia sp. nov.—det. Schaus.
(Specimens in National Museum.)

Semiothisa enotata Packard
Möschler. Gundlach.
(One unlabeled specimen — det. Schaus).

Semiothisa infimata Guenee
Möschler. Gundlach.

Semiothisa diffusata Guenee—det. Dyar
at light at Guánica (627–13).

Semiothisa bisignata Möschler 89–248, TYPE from Porto Rico.
Gundlach.

Semiothisa cellulata Herr. Sch.
Möschler. Gundlach.

Semiothisa sp.—det. Schaus
larvae defoliating flamboyan, *Poinciana regia* (827–16), at Guánica (209–15).

Apicia distycharia Guenee
Möschler. Gundlach.

Moschleria hulstii Möschler 89–235, TYPE from Porto Rico.
Gundlach.

Drepanodes ephyrata Guenee
Möschler. Gundlach.

Drepanodes infensata Guenee
Möschler. Gundlach.

Sericoptera mahometaria Herr. Sch.
Stahl.

Sericoptera area Cramer
Möschler. Gundlach.

Nepheloleuca politia Cramer
(as *Urapteryx*) Stahl. (as *Urapteryx* and as *U. complicata* Guenee, not in synonymy) Möschler. Gundlach.
(Three unlabeled specimens — det. Schaus).

Microgonia vesulia Cramer
(as *Oxydia quadriagliata* Guenee) Stahl.
(as *Oxydia*) Möschler. Gundlach, "Estas especies varían muchísimo. Möschler describe diez variedades."
Van Z. (P. R. 1450).
at light at Guánica (566–13 det. Dyar); larva, a large grey looper, on leaves of wild orange at Cayey (35–21) pupated in slight cocoon; larva on *Acalypha wilkesiana* (9–19).

Certima dositheata Guenee
(as *Microgonia*) Möschler. Gundlach.

Azelina vetustaria Walker—det. Schaus.
(One unlabeled specimen.)

Pero rectisectaria Herr. Sch.
Möschler. Gundlach.

Pero curvistrigaria Herr. Sch.
Stahl.

Thysanopyga apicitruncaria Herr. Sch.
Möschler. Gundlach.

Brothis vulneraria Hübner
Stahl. Möschler. Gundlach.

Alcis momaria Guenee
(as *Boarmia*) Möschler. Gundlach.
(One unlabeled specimen — det. Schaus).

Alcis abjectaria Herr. Sch.
(as *Boarmia*) Möschler. Gundlach.

Alcis delicata Butler
(as *Boarmia*) Möschler. Gundlach.

Alcis hilararia Möschler (as **Boarmia**) 89–266, TYPE from Porto Rico.
(as *Boarmia*) Gundlach.

Bronchelia pudicaria Guenee
(as *Boarmia*) Stahl. Möschler. Gundlach.

Bronchelia scolopacea Drury
(as *Boarmia*) Möschler. Gundlach.

Amphidasys arnobia Cramer
(as *Thyrinteina quadricostaria* Herr. Sch.) Möschler. Gundlach.

Bombycodes simplicaria Guenee
Möschler. Gundlach.

Melanchroia geometroides Walker
Stahl.

Melanchroia cephise Cramer
Van Z. (1663) on *Phyllanthus lathyroides.*
Van Zwaluwenburg 15–31: "a local outbreak at Camuy, where the larvae practically stripped the grosella trees, *Phyllanthus distichus.*"
on weeds in cane fields (105–12, 828–16), at flowers of *Mitrocarpus portoricensis* (719–14 det. Dyar), at flowers of *Heliotropium* at Añasco (507–13); larvae on *Phyllanthus lathyroides* (718–14, 720–14, 316–16, 327–16, 548–16).

Hydratoscia fenestraria Guenee—det. Dyar
Van Z. (1601) on *Genipa americana.*
larvae on leaves of unidentified tree (175–21) have dark purplish-brown head and five large irregularly rectangular spots of this color on the anterior abdominal segments, alternating with areas of dull green (the ground color) of approximately the same size, with small purplish spots on the second and third thoracic segments, and smaller purplish spots on the other segments.

Cnemodes perletaria Möschler 89–240, TYPE from Porto Rico.
Gundlach.

Cnemodes malefidaria Möschler 89–240, TYPE from Porto Rico.
Gundlach.

Zonosoma occipitraria Herr. Sch.
Stahl. Möschler. Gundlach.

Zonosoma delectabiliaria Möschler 89–236, TYPE from Porto Rico.
Gundlach.

Hyria opulentaria Möschler (as **Acidalia**) 89–237, TYPE from Porto Rico.
(as *Acidalia*) Gundlach.

Hyria flavomarginata Möschler (as **Acidalia**) 89–237, TYPE from Porto Rico.
(as *Acidalia*) Gundlach.

Idaea chionaeata Herr. Sch.
(as *Acidalia*) Stahl. Möschler. Gundlach.
(One unlabeled specimen — det. Schaus).

Idaea eburneata Guenee
(as *Acidalia*) Möschler. Gundlach.

Idaea tortuosaria Möschler (as **Acidalia**) 89–237, TYPE from Porto Rico.
(as *Acidalia*) Gundlach.

Ptychopoda offendata Möschler (as **Acidalia**) 89–238, TYPE from Porto Rico.
(as *Acidalia*) Gundlach.

Craspedia crenatilineata Warren—det. Schaus.
(One unlabeled specimen.)

Pleuroprucha molitaria Möschler 89–238, TYPE from Porto Rico.
Gundlach.

Hemiptilota insulsaria Guenee—det. Schaus.
from pupa on cane leaf at Yauco (259–21).

Leptostales oblinataria Möschler 89–239, TYPE from Porto Rico.

Leptostales devolutaria Möschler 89–239, TYPE from Porto Rico.

Leptostales praepeditaria Möschler 89–239, TYPE from Porto Rico.

Leptostales mutuataria Möschler 89–239, TYPE from Porto Rico.

Leptostales tumidaria Möschler 89–240, TYPE from Porto Rico.

Leptostales instutaria Möschler 89–240, TYPE from Porto Rico.
Gundlach.
"Most of these names are probably synonyms." Schaus.

Apallacta pryrrhularia Möschler 89–242, TYPE from Porto Rico.
Gundlach.

Calyptocoma phorcaria Guenee
(as *Zonosoma*) Möschler. Gundlach.

Racheospila confundaria Möschler 89–242, TYPE from Porto Rico.
Gundlach.

Racheospila ocellata Stoll
Möschler. Gundlach.

Phrudocentra centrifugaria Herr. Sch.
(as *Racheospila anomalaria* Möschler 89–243, TYPE from Porto Rico) Gundlach.

Eucrostis albocostaria Herr. Sch.
Stahl. Möschler. Gundlach.

Geometra attendaria Möschler 89–243, TYPE from Porto Rico.
Gundlach.

Scordylia quadruplicaria Hübner
Möschler. Gundlach.

Cambogia snellenaria Möschler
(as *Asthena*) Möschler. Gundlach.

Pterocypha praecurraria Möschler (as **Spargania**) 89–269, TYPE from Porto Rico.
Gundlach.

Pterocypha defensata Walker—det. Schaus.
(One unlabeled specimen.)

Rhopalodes castniata Guenee
Möschler. Gundlach.
"Probably wrong." Mr. Schaus.

Cidaria aristata Herr. Sch.
Möschler. Gundlach. (as *Larentia*) Stahl.

Cidaria baliata Herr. Sch.
Möschler. Gundlach.

Cidaria balteolata Herr. Sch.
Möschler. Gundlach. (as *Larentia*) Stahl.

Cidaria elutata Herr. Sch.
(as *Larentia*) Stahl.

Cidaria chloronotata Möschler 89–273, TYPE from Porto Rico.
Gundlach.

Cidaria vinaceata Möschler 89–274, TYPE from Porto Rico.
Gundlach.

Terenodes aureocapitaria Möschler 89–274, TYPE from Porto Rico.
Gundlach.

(**Terenodes mirandilis**
Stahl.)

Syllexis intamiataria Möschler 89–241, TYPE from Porto Rico.
Gundlach.

Mecoceras nitocris Cramer
Möschler. Gundlach.

Almodes squamigera Felder
(as *Boarmia*) Möschler. Gundlach.
"not found in P. R." Mr. Schaus.

PSYCHIDÆ.

Oeceticus kirbyi Guilding
Möschler. Gundlach, "La oruga vive sobre *Persea, Cupania, Terminalia,* etc."

MEGALOPYGIDÆ.

Megalopyge krugii Dewitz (as **Lagoa**) 77–95, TYPE from Porto Rico.
(as *Megalopyga*) Möschler 89–122. Gundlach 91–465 (No. 148).
Van Z. (1662) on *Inga vera, Terminalia catappa* and coffee.
Van Zwaluwenburg 15–31: on guama, *Inga laurina,* and coffee.
Van Zwaluwenburg 15–34: "The larva is covered with long white hairs and is provided with brittle spines which cause a burning sensation if allowed to come in contact with the skin. The pupa-case, with a 'trap-door' exit at one end, 16 × 10 mm., is formed of the hairs of the larva mixed with a substance secreted by the mature larva."

at light at Guánica (565–13); larvae on grapefruit (106–16), on guava, *Psidium guajava* (38–21 parasitized by *Chalcis robustella* Wolc.); on mangrove and *Conocarpus erectus* at Martin Peña (142–23); on cacao at Ciales (470–21); cocoons very abundant on the trunks of *Erythrina glauca* trees at Cayey, and common on coffee, *Inga vera* and *Inga laurina* throughout the coffee districts. (GNW) Larva known as "plumilla". The old cocoons furnish shelter for small spiders and many small insects, especially cockroaches and ants.

THYRIDIDÆ.

Rhodoneura scallula Guenee (as **Striglina**) var. **immaculata** Möschler 89–122, TYPE from Porto Rico.
(as *Striglina*) Gundlach 91–465 (No. 149).

PYRALIDÆ.

PYRAUSTINAE.

Homophysa banderiana Fabr.
(as *H. dolatalis* Möschler 89–321, TYPE from Porto Rico) Gundlach.

Lipocosma hebescalis Möschler 89–316, TYPE from Porto Rico.
Gundlach.

"Probably not a *Lipocosma* and does not belong here." Mr. Schaus.

Zinckenia fascialis Cramer
(as *Z. recurvalis* Fabr.) Stahl. Möschler. Gundlach, "La oruga se cría en *Amaranthus* y *Celosia.*"
Van Z. (P. R. 1409). Jones 15–8: on *Amaranthus.*
Cotton 18–280: "webbing and skeletonizing the leaves of beets."

common at light at Guánica (609–13 det. Dyar); larvae on *Amaranthus* (546–12, 703–17), at Guánica (214–15); on swiss chard (550–17).

Zinckenia perspectalis Hübner
Möschler. Gundlach. Van Z. (P. R. 1437).
common at light at Guánica (598–13 det. Dyar); larvae on *Synedrella nodiflora* (366–16, 747–16, 1118–16), on *Eleutheranthera ruderalis* (399–16), on *Wedelia trilobata* (774–16, 881–16), on *Melanthera canescens* (799–16), on *Verbesina alba* (916–16) — all collections and rearings by E. G. Smyth.

Pycnarmon receptalis Walker
(as *Spilomela personalis* Herr Sch.) Möschler. Gundlach.

Desmia tages Cramer
Stahl. (as *Desmia sertorialis* Herr. Sch.) Möschler. Gundlach.

Desmia ufeus Cramer
(as *Desmia orbalis* Guenee and as *Desmia viduatalis* Möschler 89–311, TYPE from Porto Rico) Möschler. Gundlach.
at Camuy (EGS); larvae on *Cissus sicyoides* (562–21 det. Schaus).

Desmia naclialis Snell
Möschler. Gundlach: possibly the female of *Desmia amillalis* Snell.

Maruca testulalis Geyer—det. Dyar
Cotton 18–279: as the "Bean Pod-Borer", notes and control.
(198–12, 792–12), common at light at Guánica (583–13); larvae on sword beans (868–14).

Synclera traducalis Zeller
Möschler. Gundlach. (as *Pagyda*) Van Z. (P. R. 1440)
at light at Guánica (607–13 det. Dyar).

Ercta vittata Fabr.
(as *Euclasta torquillalis* Möschler 89–302, TYPE from Porto Rico) Gundlach.
rare at light at Guánica (652–13 det. Schaus).

Marasmia cochrusalis Walker
(as *Cnaphalocrocis perpersalis* Möschler 89–293, TYPE from Porto Rico) Gundlach.
(One unlabeled specimen — det. Schaus).

Syngamia florella Cramer
Stahl. Möschler. Gundlach.
(669–12 det. Schaus); at Aibonito (SSC).

Syngamia haemorrhoidalis Guenee
(as *Salbia*) Möschler. Gundlach.

Syngamia cognatalis Snell
(as *Salbia*) Möschler. Gundlach.

Syngamia praeformatalis Möschler (as **Salbia**) 89–291, TYPE from Porto Rico.
(as *Salbia*) Gundlach.

Hileithia ductalis Möschler 89–292, TYPE from Porto Rico.
Gundlach.
(One unlabeled specimen — det. Schaus).

Samea ecclesialis Guenee
(as *Samea castellalis* Guenee) Stahl. Möschler. Gundlach.

Trithyris quadrifenestalis Herr. Sch.
(as *Coenostola*) Möschler. Gundlach.

Diastichtis argyralis Hübner
(as *Botys*) Stahl. Möschler. Gundlach.

Pilocrocis lauralis Walker
(as *Spilomela pervialis* Herr. Sch.) Möschler. Gundlach.

Pilocrocis tripunctata Fabr.
(as *Acrospila campalis* Guenee) Stahl. Möschler. Gundlach.
Jones 15–9: "Sweet-potato leaves - - - webbed together and injured by the larva." Illustration of adult.
Cotton 18–309: notes.
larvae on sweet-potato (894–13, 723–17), on *Ipomoea bona-nox* (709–16).

Pilocrocis infuscalis Guenee
(as *Botys pruinalis* Lederer) Möschler. Gundlach.

Mesocondyla concordalis Hübner
(as *Acrospila*) Möschler. Gundlach.
at light at Guánica (648–13 det. Dyar); larvae on leaves of calabash tree, *Crescentia cujete* (786–12, 934–16), at Ciales (596–21); on leaves of roble tree, *Tecoma pentaphylla* (26–14), at Dorado (544–22).

Mesocondyla gastralis Guenee
(as *Acrospila*) Möschler. Gundlach.

Conchylodes diphteralis Hübner
Stahl. (as *Ledereria*) Möschler. Gundlach, "La oruga en especies de *Cordia,* y la crisálida en su capullo, hace saltar este a distancia de algunas pulgadas."

Dichogamma redtenbacheri Lederer
Möschler. Gundlach.
three adults at light at Guánica (631–13 det. Dyar).

Dichogamma amabilis Möschler 89–296, TYPE from Porto Rico.
Gundlach.

Dichogamma innocua Fabr.
(as *D. krugii* Möschler 89–296, TYPE from Porto Rico) Gundlach.

Dichogamma bergii Möschler 89–297, TYPE from Porto Rico. Gundlach.

Dichogamma fernaldi Möschler 89–297, TYPE from Porto Rico Gundlach.

Phostria prolongalis Guenee
(as *Microthyris*) Möschler. Gundlach.

Phostria humeralis Guenee
(as *Omiodes*) Möschler. Gundlach.

Phostria insolutalis Möschler (as **Omiodes**) 89–301, TYPE from Porto Rico.
(as *Omiodes*) Gundlach.

Phostria martyralis Lederer
(as *Coenostola*) Möschler. Gundlach

Coenostola eruptalis Lederer
Möschler Gundlach.

Lamprosema inabsconsalis Möschler (as **Diasemia**) 89–306, TYPE from Porto Rico.
(as *Diasemia*) Gundlach.

Lamprosema subulalis Guenee
(as *Sisyracera preciosalis* Möschler) Möschler. Gundlach.

Lamprosema zoilusalis Walker
(as *Botys hilaralis* Möschler) Möschler. Gundlach.

Lamprosema xanthialis Guenee
(as *Botys incalis* Snell, var. *rosealis* Möschler 89–285, TYPE of the variety from Porto Rico) Gundlach.

Lamprosema indicata Fabr.
(as *Hedylepta vulgalis* Guenee) Stahl. Möschler. Gundlach, "La oruga se cría entre las hojas reunidas de plantas de la familia de las papilionáceas."
(as *Nacoleia*) Jones 15–9: larvae on beans and cowpeas. Illustration of adult. Cotton 18–278: as the "Bean Leaf-Webber." "The small dirty-green colored larva webs the leaves (of bean) together, living between them and skeletonizing them with its feeding." Control.

larvae on cowpeas (2–12), on beans (RTC), on ***Lantana camara*** (763–16), on ***Meibomia tortuosa*** (1091–16), on ***Vigna repens*** (1136–16); on peas and beans at Vega Baja (362–21), parásitized by ***Argyrophylax albincisa*** Wied., a Tachind fly.

Lamprosema lunulalis Hübner
Möschler. Gundlach.

Sylepta gordialis Guenee
(as *Asciodes*) Stahl. Möschler. Gundlach.
larvae on leaves of Bougainvillea vine at Pt. Cangrejos (GNW — det. Dyar).

Sylepta titubalis Möschler (as **Asciodes**) 89-303, TYPE from Porto Rico.
(as *Asciodes*) Gundlach.

Sylepta scopulalis Guenee
(as *Asciodes*) Möschler. Gundlach.

Sylepta helcitalis Walker
(as *Crossophora miscellalis* Möschler 89-308, TYPE from Porto Rico) Gundlach.

Sylepta patagialis Zeller
(as *Herpetogramma servalis* Lederer) Möschler. Gundlach.

Sylepta silicalis Guenee—det. Dyar
larva a leaf-roller on *Didymopanax morototoni* at Lares (133-22).

Sylepta elevata Fabr.—det. Dyar
at light (394-16), at Guánica (595-13).

Sylepta onophasalis Walker—det. Schaus.
(One unlabeled specimen.)

Sathria stercoralis Lederer
Stahl. Möschler. Gundlach.

Lygropia lelex Cramer
(as *Cyclosena gestatalis* Möschler 89-309, TYPE from Porto Rico) Gundlach.
larva on *Ipomoea* sp. (564-21 det. Schaus).

Margaronia flegia Cramer—det. Schaus.
larva on *Thevetia thevetia* at Pt. Salinas (Plantaje) (695-16).

Margaronia aurocostalis Guenee
(as *Pachyarches*) Möschler. Gundlach.
at light at Guánica (672-13 det. Schaus); larva on leaf of *Rauwolfia nitida*, folding over half of it to make a bag, in which it lived and on the interior of which it fed at Camuy (331-22).

Margaronia nitidalis Cramer
(as *Phacellura*) Möschler. Gundlach. (as *P. hylinasalis*) Stahl.

Margaronia infernalis Möschler (as **Phacellura**) 89–300, TYPE from Porto Rico.
(as *Phacellura*) Gundlach.

Margaronia hyalinata Linn.
(as *Phacellura*) Möschler. Gundlach, "La oruga se cría en curcurbitaceas y también en *Ipomea.*"
(as *P. immaculalis* Guenee) Stahl.
(as *Diaphania*) Barrett 03–448; Jones 16–8; Cotton 18–294; Van Z. (920) on Curcurbitaceae.
at light (51–12, 159–12, 24–19), at Guánica (602–13) very common; larvae on cucumbers (106–12, 547–12, 629–17, 633–17), on cantaloupe (286–16), on watermelon (314–16).

Margaronia elegans Möschler (as **Phacellura**) 89–299, TYPE from Porto Rico.
(as *Phacellura*) Gundlach.

Margaronia fuscicaudalis Möschler
(as *Phacellura*) Möschler. Gundlach.

Margaronia lucidalis Hübner
(as *Phacellura*) Stahl. Möschler. Gundlach.

Margaronia quadristigmalis Guenee
(as *Margarodes*) Möschler. Gundlach.
at light at Guánica (672-13 det. Schaus).

Margaronia isoscelalis Guenee
(as *Margarodes*) Möschler. Gundlach.

Margaronia sibillalis Walker
(as *Glypodes*) Möschler. Gundlach.
(Unlabeled specimens — det. Schaus); larva on *Morus alba* (410–22).

Margaronia ausomia Cramer
(as *Hoterodes*) Stahl. Möschler. Gundlach.

Diaphantia conspicualis Möschler 89–314, TYPE from Porto Rico.
Gundlach.

Agathodes designalis Guenee
(as *Stenurges*) Möschler. Gundlach.
larva on *Erythrina glauca* (869–16, 327–21 det. Dyar) rolling leaves and boring in stem; on *Citharexylum fructocosum* (15–17); fully grown larvae boring in bark of large *Erythrina glauca* and *Inga vera* trees at Cayey (381–22).

Cliniodes semilunalis Möschler 89–297, TYPE from Porto Rico.
Gundlach.

Syllepsis marialis Poey
Möschler. Gundlach.

Leucinodes elegantalis Guenee
Möschler. Gundlach.
at light (636–16, 197–17 det. Schaus).

Ommatospila narcaeusalis Walker
(as *O. nummulalis* Lederer) Möschler. Gundlach.
(Unlabeled specimens — det. Schaus.)

Hellula undalis Fabr.
Möschler. Gundlach.

Hellula phidilealis Walker—det. Schaus
(One unlabeled specimen.)

Epipagis conjunctalis Möschler (as **Samea**) 89–290, TYPE from Porto Rico.
(as *Samea*) Gundlach.

Epipagis togalis Lederer
(as *Botys*) Stahl. Möschler. Gundlach.

Terastia meticulosalis Guenee—det. Schaus & Dyar
larvae bore in twigs of *Erythrina glauca* trees, ninety per cent of those in an experimental planting at the Station being infested (326–21).

Orobena implicitalis Mööschler 89–292, TYPE from Porto Rico.
Gundlach.

Catacteniza (Azochis) euvexalis Möschler 89–314, fig. 13, TYPE from Porto Rico.
Gundlach.
at light at Guánica (647–13 det. Schaus).

Crocidophora huronalis Guenee
(as *Stenophyes serinalis* Walker) Möschler. Gundlach.
(810–14 det. Dyar), from Algarrobo (814–14).

Psara periusalis Walker
(as *Pachyzancla*) Jones 15–9: "The young larvae live at first as miners in the leaves (of eggplant and *Solanum torvum*), but later web the leaves together." Notes and description of adult. Illustration of work. Cotton 17–109: "The Tobacco Leaf-Folder" — an extended account (5 pp.) with description of all stages, life-history and control. Cotton 18–299: as leaf-folder of eggplant, notes and control.
Wolcott 22c–10: "El Pega-Pega del Tabaco".
common at light at Guánica (663–17); larvae on *Solanum torvum* (176–12, 397–16, 796–16, 924–16), on eggplant (787–12, 984–16), on *Solanum nigrum* (376–16, 745–16), on tomato (189–15), on wild tomato (826–16), on tobacco (94–20), at Aguadilla (137–20), at Cayey (9–23), the most abundant insect on shade-grown tobacco, but less abundant on the sunny hills.

Psara phaeopteralis Guenee—det. Dyar
larvae abundant in pasture eating St. Augustine or "gramma" grass, *Stenotaphrum secundatum*, at Hatillo (224–21).

Psara bipunctalis Fabr.
(as *Botys detritalis* Guenee) Möschler. Gundlach.
(as *Pachyzancla*) Jones 15–8: on *Amaranthus*. Cotton 18–280: "on beets, chard and *Amaranthus*." Notes and control. Van Z. (P. R. 1438).
at light at Guánica (601–13, 661–13); larvae on *Amaranthus* (178–11, 219 to 223–11, 336–16, 355–16), on beets (408–13), on eggplant (1008–16), on swiss chard (551–17, 584–17, 589–17), on *Achryanthes indica* (898–16), on *Borreria ocimoides* (380–16).

Phlyctaenodes ? pertentalis Möschler (as **Botys**) 89–284, fig. 7, TYPE from Porto Rico.
(as *Botys*) Gundlach.

Phlyctaenodes ? placendalis Möschler (as **Botys**) 89–285, TYPE from Porto Rico.
(as *Botys*) Gundlach.

Phlyctaenodes viscendalis Möschler (as **Botys**) 89–285, TYPE from Porto Rico.
(as *Botys*) Gundlach.

Phlyctaenodes bifidalis Fabr.
(as *Eurycreon evanadalis* Berg.) Möschler. Gundlach.
Van Z. (P. R. 1407).
common at light at Guánica (597–13, det. Dyar & Schaus).

Phlyctaenodes nudalis Hübner
(as *Eurycreon*) Möschler. Gundlach.

Phlyctaenodes similalis Guenee—det. Dyar
at light at Guánica (662–13).

Phlyctaenodes collucidalis Möschler (as **Eurycreon**) 89–290, TYPE from Porto Rico.
(as *Eurycreon*) Gundlach.
"Probably a variety of *similalis* Guenee." Mr. Schaus.

Diasemia ramburialis Dup., var. **minimalis** Möschler 89–306, TYPE of the variety from Porto Rico.
Gundlach.

Sparagmia gigantalis Guenee
Möschler. Gundlach.
larva on grayumbo macho, *Didymopanax morototoni* at Lares (159–22 det. Schaus).

Mecyna glivata Fabr.
(as *Botys polygonalis* Hübner) Möschler. Gundlach.

Epicorsia mellinalis Hübner
(as *Botys oedipodalis* Guenee) Möschler. Gundlach.
(as *Pyrausta*) Van Z. (P. R. 1411).
very common at light at Guánica (581–13 det. Dyar), larvae abundant on *Citharexylum fruticosum* and *Vitex divaricata* at Aibonito and Trujillo Alto (68–23). Fully-grown larvae semitransparent green, 28–30 mm. long, with cadmium yellow head, on which are several small black spots subtending hairs. The first and last segments of the body with numerous small black spots, the other segments marked dorsally with four quite large black spots, irregularly oval, arranged in a square, each spot with a clear space near the center about the base of a hair; laterally a thick irregular black ring about the base of a hair above the spiracles, and below a narrower black ring around two black dots, each the base of hairs; ventrally a very narrow black ring around the black base of a hair and a group of three black-based hairs on each side of most segments. Legs transparent light yellow.
Cocoons of brown silk, of three distinct layers, formed in a folded-over leaf. Pupal period ten to twelve days.

Epipagis cambogialis Guenee
(as *Botys*) Möschler. Gundlach.
(One unlabeled specimen — det. Schaus.)

Pyrausta oculatalis Möschler (as **Botys**) 89–282, TYPE from Porto Rico.
(as *Botys*) Gundlach.

Pyrausta illutalis Guenee
(as *Condylorrhiza*) Möschler. Gundlach.

Pyrausta cardinalis Guenee
(as *Botys*) Möschler. Gundlach.
at light at Aibonito (SSC — det. Schaus).

Pyrausta episcopalis Herr. Sch.
(as *Botys*) Möschler. Gundlach.

Pyrausta phoenicealis Hübner
(as *Botys* and as *Botys insignitalis* Guenee) Möschler. Gundlach.
larva on *Hyptis capitata* (323–16 det. Schaus).

Pyrausta tyralis Guenee
(as *Botys diffusa* G. & R.) Möschler. Gundlach.

Pyrausta glorialis Herr. Sch.
(as *Botys*) Möschler. Gundlach.

Pyrausta gracilalis Herr. Sch.
(as *Botys*) Möschler. Gundlach.

Botys citrinalis Möschler 89–282, TYPE from Porto Rico.

Botys albifrontalis Möschler 89–284.

Botys villicalis Möschler (described from Jamaica).

Botys principaloides Möschler 89–285.

Botys intricatalis Möschler 89–286.

Botys terricolalis Möschler (described from Surinam).

Botys evincalis Möschler 89–287.

Botys concinnalis Möschler 89–287.

Botys fortificalis Möschler 89–288.

Botys secernalis Möschler 89–288.

Botys flammeolalis Möschler 89–289.
Gundlach.
"Not placed" by Mr. Schaus.

Noctuelia thalialis Walker
Van Z. (P. R. 1412).
very common at light at Guánica (636–13 det. Schaus).

Stenoptycha pterophoralis Walker
(as *Lineodes gracilalis* Herr. Sch.) Möschler. Gundlach.

Lineodes metagrammalis Möschler 89–305, TYPE from Porto Rico.
Gundlach.

Lineodes triangulalis Möschler 89–305, TYPE from Porto Rico.
Gundlach.

Cerobasis pachylefidella Hamp.
Van Z. (1612) or (62) on *Hepatica (Herpetica) alata.*

NYMPHULINÆ.

Paraponyx infirmalis Möschler
Möschler. Gundlach.

Paraponyx rugosalis Möschler 89–318, TYPE from Porto Rico.
Gundlach.
(One unlabeled specimen — det. Schaus.)

Paraponyx vestigialis Snell
Möschler. Gundlach.

Cataclysta opulentalis Lederer
Möschler. Gundlach.

Cataclysta angulatalis Lederer
Möschler. Gundlach.

Cataclysta sumptuosalis Möschler 89–319, TYPE from Porto Rico Gundlach.

Cataclysta miralis Möschler 89–319, TYPE from Porto Rico. Gundlach.
(Unlabeled specimens — det. Schaus.)

Cataclysta minimalis Herr. Sch.
Stahl.

Argyractis plusialis Herr. Sch.—det. Schaus.
common at light at Guánica (646–13).

Piletocera bufalis Guenee
(as *Penestola praeficalis* Möschler 89–316, TYPE from Porto Rico Gundlach 91–553, No. 540.

Somatania pellucidalis Möschler 89–301, fig. 22, TYPE from Porto Rico.
Gundlach 91–545, No. 505.
" =*Stenia samealis* Dyar" Mr. Schaus.

EPIPASCHIINAE.

Tetralopha scabridella Ragonot
Möschler. Gundlach.
Brown larvae with lighter-colored medio-dorsal stripe bordered with black, web together several terminal leaves of *Inga vera,* making "nidos de las mariposas", at Lares (160–22 det. Schaus), at Cayey (386–22), common on host throughout the coffee districts.

Pococera atramentalis Lederer
(as *Philotricha erigens* Ragonot) Möschler. Gundlach.
Van Z. (1226) on mango and (1626) on *Clerodendron squamatum.*
(Unlabeled specimens — det. Schaus.)

Pococera insularella Ragonot
Möschler. Gundlach.

Jocara ragonoti Möschler (as **Deuterollyta**) 89–280, TYPE from Porto Rico.
(as *Deuterollyta*) Gundlach 91–530, No. 431.

Jocara majuscula Herr. Sch.
(as *Deuterollyta infectalis* Möschler 89–279, TYPE from Porto Rico) Gundlach 91–530, No. 430.

Stericta alnotha Schaus, Wm., Proc. Ent. Soc. Washington, Vol. 24, No. 9, p. 239, 1922: TYPE from Porto Rico.

CHRYSAUGINAE.

Tamyra albomaculalis Möschler 89–278, TYPE from Porto Rico. Gundlach.

Pachymorphus subductellus Möschler 89–324, TYPE from Porto Rico.
Gundlach.
at light (284–22); larvae boring in twigs of roble, *Tecoma pentaphylla* (426–12 det. Schaus).

Carcha herselialis Walker
(as *Coeloma tortricalis* Möschler 89–277, TYPE from Porto Rico) Gundlach.

Ethnistis munitalis Lederer
Möschler. Gundlach.
larvae in seed pods of roble, *Tecoma pentaphylla* (889–16 det. Schaus, 328–21 det. Dyar).

Callasopia rosealis Möschler 89-275, TYPE from Porto Rico.
Gundlach.
"Probably a synonym of *Caphys bilinea* Walker." Mr. Schaus.

Stretopalpia minusculalis Möschler (as **Tamyra**) 89–278, TYPE from Porto Rico.
(as *Tamyra*) Gundlach.
(Unlabeled specimens det. Schaus as *S. deera* Druce.)

Ballonicha recurvata Möschler
Möschler. Gundlach 91–509, No. 341.

PYRALINAE.

Pyralis manihotalis Guenee
(as *Parasopia dissimilalis* Möschler 89–276, TYPE from Porto Rico) Gundlach.
larvae feeding on rice (252–17, 22–16), on corn meal and rice (614–17 det. R. T. Cotton).

Pyralis (Asopia) gerontesalis Walker
Möschler. Gundlach.

SCHOENOBIINAE.

Scirpophaga albinella Cramer
(as *S. leucatea* Zeller) Möschler. Gundlach.
(as *Rupella*) Van Z. (P. R. 1410).
common at light at Guánica (600–13 det. Dyar).

Scirpophaga longicornis Möschler 89–321, TYPE from Porto Rico.
Gundlach.
at light (1215–13 det. Schaus).

CRAMBINAE.

Crambus ligonellus Zeller
Möschler. Gundlach.
(Unlabeled specimens — det. Schaus.)

Crambus detomatellus Möschler 89–322, TYPE from Porto Rico. Gundlach.

Crambus discludellus Möschler 89–323, TYPE from Porto Rico. Gundlach.

Crambus gestatellus Möschler 89–323, TYPE from Porto Rico. Gundlach.

Crambus fissiradiellus Walker—det. Schaus
(Unlabeled specimens.)

Crambus hastiferellus Zeller
(as *C. quinquarcatus* Zeller) Möschler. Gundlach.
resting on sugar cane at Manatí (103–21 det. Dyar).

Argyra diplomachalis Dyar—det. Schaus
on weeds and at light (833–16).

Argyra lusella Zeller
Möschler. Gundlach.

Argyra nivalis Drury
Möschler. Gundlach.

Diatraea saccharalis Fabricius
(as *Diatraea obliterattella* Zeller) Möschler. Gundlach.
Busck 00–89: the larvae boring in stalks of sugar cane. "The annual cutting and crushing the cane with all living larvae and pupae naturally keeps the pest in check, but the remaining roots and single canes always contain enough individuals to infest the next year's growth."
May 06–10: recommends that "seed-cane be soaked twenty-four hours before planting to destroy (the larvae).
Tower 07–28: the same recommendation.
Van Dine 11–45: an extended preliminary account.
Van Dine, D. L., "Damage to Sugar Cane Juice by the Moth Stalk-Borer (*Diatraea saccharalis* Fabr.)." Circ. No. 1, Expt. Station P. R. S. P. A., Río Piedras, 1912, pp. 1–11.
Van Dine 12–16: additional notes.
In lists of insect pests of sugar cane by Van Dine 13–251, Van Dine 13–28 and Smyth 19–144.
Van Z. (303) on sugar cane, corn, guinea grass and gramma grass.
Jones, Thos. H., "The Sugar-Cane Moth Stalk-Borer (*Diatraea saccharalis* Fabr.)." Bull. 12, Expt. Station, Bd. Comm. Agr., P. R., Río Piedras, March 16, 1915, pp. 1–30, figs. 8: an extended account, description of stages, life-history and parasites.
Johnston 15–24: as host of *Cordyceps barberi.*
Wolcott, G. N., "Influence of Rainfall and Burning the Trash

on the Abundance of *Diatraea saccharalis*" Circ. 7, Insular Experiment Station, Río Piedras, 1915, pp. 1–6, map.

Wolcott 17–80: a continuation of the observations reported in Circ. No. 7, with map.

Stevenson 18–218: as host of *Isaria (Cordyceps) barberi* Giard.

Cotton 18–290: a pest of corn. Illustration of pupa and adult.

Colon 19–40: a summary of the work on *Diatraea* at the Insular Station to date.

Wolcott 21–36: notes.

Wolcott, G. N., "The Influence of the Variety of Sugar Cane on Its Infestation by *Diatraea saccharalis* Fabr., and the Other Factors Affecting the Abundance of the Moth Borer." Jour. Dept. Agr. P. R., Vol. 6, No. 1, Jan. (October) 1922, pp. 21–31: illustrations of *Trichogramma minutum* Riley and *Prophanurus alecto* Crawford, the parasites of the eggs in Porto Rico.

Wolcott 23–55: unsuccessful use of larvae as vectors in transmission of gumming disease of sugar cane.

at light (154–13, 452–13), at Arecibo (148–13), at Guánica (551–13 det. Dyar), at Luquillo (199–13); emerged through 1½ inches of soil (967–13); larvae on sugar cane (165–11, 9–12 det. Dyar, 327–12, 264–13, 356–13, 421–13, 939–13, 96A–18, 69–19, 109–21), at Arecibo (184–11), at Santa Isabel (130–13), at Aguirre (26–11, 28–11), at Luquillo (276–13), killed by *Cordyceps (Isaria)* fungus at Guánica (45–10, 33–11), at Santa Isabel (184–12); larvae on corn (53–12 det. Dyar, 610–17, 617–17, 631–17), at Caguas (325–21); larvae on elephant grass at Humacao (682–18), on *Hymenachne amplexicaule* (934–13), on malojillo, *Panicum barbinode* (882–13, 909–13 det. Dyar), on grass and cane at Guánica (231–11, 171–13), at Patillas (175–12); eggs on rice at Comerío (940–13 — adults, reared on sugar cane, det. Dyar).

Chalcoela discedalis Möschler 89–320, TYPE from Porto Rico. Gundlach.

(unlabeled adult — det. Schaus.)

GALLERIINAE.

Galleria mellonella Linnaeus

Möschler. Gundlach. Van Z. (1720).

Corcyra cephalonica Stainton

Chittenden, F. H., "The Rice Moth" Bull. 783, U. S. Dept. Agr., July 14, 1919, pp. 1–15: Porto Rican records of eggs laid in sacks of cereals, larvae abundant in rice and reared from chocolate.

larvae attacking dry garbanzos or chick peas (543–22 det. R. T. Cotton).

PHYCITINAE.

Myelois furvidorsella Ragonot
Möschler. Gundlach.

Crocidomera turbidella Zeller
Möschler. Gundlach.
(Unlabeled specimens — det. Schaus.)

Crocidomera fissuralis Walker
Möschler. Gundlach.

Fundella pellucens Zeller
Möschler. Gundlach.

Fundella cistipennis Dyar
(as *Pachyzancla bipunctalis* Fab.) Jones 15–8: attacking garden beans and sword beans, *Canavalia ensiformis*. Notes.
(as *Ballovia*) Cotton 18–292: the stalk and pod borer of cowpeas. Notes and illustration of adult.
larvae boring in stalks and stems of cowpeas (66–12 det. Dyar, 709–17), of sword beans (219–12, 875–14, 879–14, 880–14), of *Cassia occidentalis* (881–14).

Piesmopoda rubicundella Zeller
Möschler. Gundlach.

Piesmopoda rufulella Ragonot
Möschler. Gundlach.

Piesmopoda columella Zeller
Möschler. Gundlach.

Cuba furculella Dyar
(Unlabeled specimens — det. Schaus.)

Salebria famula Zeller
Möschler. Gundlach.

Elasmopalpus lignosellus Zeller
Möschler. Gundlach.

Elasmopalpus rubedinellus Zeller
Möschler. Gundlach.
abundant flying over land just plowed at Maunabo (541–12 det. Schaus).

Oligochroa pellucidella Ragonot
Möschler. Gundlach.

Laetilia portoricensis Dyar, H. G., TYPE from Porto Rico.
larvae feeding on scale insects, *Lecanium* sp., on *Cajanus indicus* at Mameyes (995–13 det. Dyar, TYPE); larvae on withered stems of *Eupatorium odoratum* (896–16 det. Schaus).

Oncolabis anticella Zeller
Möschler. Gundlach.

Homoeosoma maturella Zeller
Möschler. Gundlach.

Homoeosoma exiguella Ragonot
Möschler. Gundlach.

Plodia interpunctella Hübner
larvae in dry dates (108–21 det. J. D. More).

Etiella zinckenella Treitschke
Möschler. Gundlach.

Pempelia diffisella Zeller
Möschler. Gundlach.

COSSIIDAE.

Psychonoctua sp. nov.—det. Schaus
Hooker 13–35: "a lepidopterous borer, determined by Dr. H. G. Dyar as *Psychonoctua* sp., which was reported by Tower (08–27) as boring in orange, citron, rose-apple and sweet almond, has done considerable damage, where the trunks and larger branches of the coffee plants are riddled with canals."
Van Zwaluwenburg 17–516: tentatively determined by Dr. Dyar as *P. jamaicensis* Schs., "most often found in old coffee at altitudes up to 1,500 ft., pruning and burning invaded wood" as control.
in coffee grove in mountains north of Yauco (245–22); larvae in coffee at Villalba (359–21), at Lares (55–22).

PTEROPHORIDÆ.

Pterophorus basalis Möschler (as **Oedematophorina**) 89–345, TYPE from Porto Rico.
Gundlach.

Pterophorus paleaceus Zeller
Möschler. Gundlach.

Pterophorus sp.—det. Busck.
larva on *Ipomoea rubra* (892–16).

Adaina bipunctata Möschler (as **Pterophorus**) 89–346, TYPE from Porto Rico.
Gundlach.

Adaina participata Möschler (as **Pterophorus**) 89–346, TYPE from Porto Rico.
Gundlach.

Adaina praeusta Möschler (as **Pterophorus**) 89–346, TYPE from Porto Rico.
Gundlach.

Platyptilia pusillidactyla Walker (or near this species)
larvae on *Caperonia palustris* (390–16, 313–16), on *Caperonia regalis* (as *Oxyptilus* sp.—det. Busck, 577–12).

ALUCITIDÆ.

Alucita eudactila Felder & Regenhofer
Möschler. Gundlach.

OLETHREUTIDÆ.

Olethreutes sp. (near **malachitana** Zeller)—det. Dyar.
larvae light olive green, head light brown, webs together leaflets of *Phyllanthus lathyroides* (978–13, 288–16, 393–16).

Phoxopteria virididersana Möschler 89–334, TYPE from Porto Rico.
Gundlach.

Grapholitha excitana Möschler 89–333, TYPE from Porto Rico.
Gundlach.

Grapholitha longipalpana Möschler 89–333, TYPE from Porto Rico.
Gundlach.

TORTRICIDÆ.

Archips sp.—det. Smyth
larvae on *Spondias lutea* (880–16), on *Malachra rotundifolia* (901–16).

Tortrix affaetana Möschler 89–330, TYPE from Porto Rico.
Gundlach.

Tortrix insignitana Möschler 89–330, TYPE from Porto Rico.
Gundlach.

Apinoglossa comburana Möschler 89–331, TYPE from Porto Rico.
Gundlach.

PHALONIIDÆ.

Phalonia sp.—det. Busck
larvae boring in flower heads of *Erecthites hieracifolia* (332–16).

Cochylis prolectana Möschler 89–332, TYPE from Porto Rico.
Gundlach.

Cochylis tectonicana Möschler 89–332, TYPE from Porto Rico.
Gundlach.

Cochylis vicinitana Möschler 89–332, TYPE from Porto Rico.
Gundlach.

Commophila sp.—det. Busck
larvae boring in buds of *Dahlia,* causing them to wither (210–22).

EUCOSMIDÆ.

Strepsicrates smithiana Walker
reared from *Psidium guajava* (870–16).

GELECHIDÆ.

Sitotroga cerealella Oliver—det. Cotton
larvae in corn (615–17), at Vega Baja (440–21).

Phthorimaea operculella Zeller
(as *Gelechia picipella*) Barrett 05–396: "slight damage to tobacco at Aguas Buenas."
Cotton 18–299: attacking eggplant. Notes and control.
Wolcott 21–49: attacking tobacco.
Wolcott 22c–11: as "candela o candelilla", a pest of tobacco. Notes and control. Colored illustration of injury.
Wolcott 23–47: rainfall an important factor in control.
larvae mining in leaves of eggplant (544–17, 567–17, 581–17, 591–17); in leaves of tobacco at Rincón (15–21), at Manatí, Arecibo, San Germán and Yauco (GNW).

Dichomeris manellus Möschler (as **Ipsolophus**) 89–344, TYPE from Porto Rico.
(as *Ipsolophus*) Gundlach.

Dichomeris zingarella Walsingham
reared by Mr. Busck from *Coccoloba,* San Juan, February, 1899.

Trichotaphe sp. nov.—det. Busck
a small grey moth with thick orange antennae, a large black spot near base of forewings, larva a leafroller on *Inga vera* (75–23).

Gelechia exclaratella Möschler 89–343, TYPE from Porto Rico.
Gundlach.
= *exclarella* Wen.

Gelechia costipunctella Möschler 89–344, TYPE from Porto Rico.
Gundlach.
= *G. bosquella* Chambers.

Gelechia rivulella Möschler 89–344, TYPE from Porto Rico.
Gundlach.

Pectinophora gossypiella Saunders—det. More, confirmed Heinrich.
Wolcott, More & Seín, "La Oruga Rosada de la Cápsula del Algodón en Puerto Rico" Circ. 63, Insular Experiment Station, Río Piedras. October, 1921, pp. 1–12, fig. 4. First record in Porto Rico, life history and control.
Wolcott, G. N., "The Distribution of the Pink Bollworm of Cotton, *Pectinophora gossypiella* Saunders, in Porto Rico." Jour.

Ec. Ent., Vol. 15, No. 4, August, 1922, pp. 313–314. Map, showing distribution in the spring of 1922.

Wolcott, G. N., "The Distribution of the Pink Bollworm in Porto Rico," Circ. No. 85, Insular Experiment Station, Río Piedras, P. R., pp. 3–7, map. September, 1923.

larvae in cotton bolls at Humacao (509–Aug. 13, 1921, 263–Aug. 23, 1921, 510–21, 527–22, 591–22), at Yabucoa (512–22, 513–22), at Maunabo (514–22, 529–22, 530–22), at Patillas (510–22, 536–22), at Guayama (511–22, 537–22), at Aguirre (508–21), at Salinas (531–22, 532–22, 534–22), at Fortuna (377–21), at Peñuelas (378–21), at Guayanilla (378–21), at Guánica (275–Sept. 1921, 501–22, 501A–22, 558–22), at Sabana Grande (502–22, 503–22, 561–22, 563–22, 564–22, 565–22, 566–22), at Cabo Rojo (500–22, 506–22), at Añasco (555–22 injured boll — not larva), at Córsica (567–Aug. 1922), at Coloso (556–22, injured boll — not larva), at Moca (507–22), at Bayaney, 15 km. south of Arecibo (553–22), 12 km. south of Arecibo (554–22), at Arecibo (268–Sept. 1921, 270–21, 341–21), at Camuy (269–Sept. 1921, 273–21, 504–21), at Hatillo (271–21, 272–21, 501–21, 502–21, 505–21, 506–21, 507–21, 571–22, 572–22, 576–22), at Isabela (274–21), at Garrochales (573–22), at Barceloneta (577–22), at Vega Baja (514–21, 518–22, 522–22, 525–22, 646–22, 569–22, 574–22), at Dorado (540–22, 562–22), at Pt. Cangrejos (539–22, 500–23), at Loíza (559–22), at Río Grande (588–December, 1922, 589–22), at Mameyes (519–22, 535–22), at Luquillo (590–22, 593–22), at Fajardo (513–21, 518–22, 538–22), at Naguabo (276–21, 526–22), at Las Piedras (511–21), at Juncos (592–December, 1922): larva in okra at Humacao (512–21).

ETHMIIDÆ.

Ethmia abraxella Walker
Van Z. (P. R. 1403).
adults at light at Guánica (599–13) — det. Busck.

Ethmia adustella Zeller
Van Z. (P. R. 1402).
(as *Psecadia*) Möschler. Gundlach.
adults at light at Guánica (596–13) — det. Busck.

Ethmia confusella Walker
Van Z. (P. R. 1404).
adults at light at Guánica (622–13) — det. Busck.

Ethmia xanthorrhoa Zeller
Van Z. (P. R. 1405).
(as *Psecadia*) Möschler. Gundlach.
adults at light at Guánica (604–13) — det. Busck.

Ethmia notatella Walker
Busck.

Ethmia aureoapicella Möschler (as **Psecadia**) 89–341, TYPE from Porto Rico.
(as *Psecadia*) Gundlach.

Ethmia ingricella Möschler (as **Psecadia**) 89–343, fig. 19, TYPE from Porto Rico.
(as *Psecadia*) Gundlach.
=*Ethmia confusella* Walsingham.

Ethmia kirbyi Möschler (as **Psecadia**) 89–342, TYPE from Porto Rico.
(as *Psecadia*) Gundlach.

COLEOPHORIDÆ.

Coleophora sp.—det. Busck
Wolcott 21–37: the "Sugar Cane Case-Bearer", at Toa Baja. Notes.

COSMOPTERYGIDÆ.

Cosmopteryx gemmiferella Clemens
Möschler. Gundlach.

Cosmopteryx attenuatella Walker
Busck.

Batrachedra albistrigella Möschler 89–345, TYPE from Porto Rico.
Gundlach.

Pyroderces rileyi Walsingham—det. More
larvae in old cotton bolls at Arecibo (340–21, 552–21), at Vega Baja (360–21), at Villalba (554–21), at Maunabo (530–22).

Homaledra sabulella Chambers, A. B.
larvae common on leaves of coconut palm (320–19, 69–23 det. Busck), at Arecibo (283–19); on leaves of *Livistona* palm (GNW), eating the lower side of the leaf and webbing together their excrement for a shelter, at times so common as to cause the leaves to turn brown. On coconut palms at Pt. Cangrejos, Manatí, Mayagüez, Naguabo and on Vieques Island (GNW).

YPONMEUTIDÆ.

Trichostibas sordidata Zeller
Busck.

Yponomeuta triangularis Möschler 89–339, TYPE from Porto Rico.
Gundlach.
larvae making nests between leaves of *Elaeodendron xylocarpum* at Boquerón (112–23 det. Busck), at Pt. Salinas (GNW).

Euarne obligatella Möschler 89–340, TYPE from Porto Rico.
Gundlach.

(**Mieza abulata** Herrich Schaeffer
Dewitz 77–95.)

Plutella maculipennis Curtis
(as *Plutella xylostella* Linnaeus) Möschler. Gundlach.
Barrett 04–448: on cabbage.
Tower 08–35: on cabbage, kale, mustard and turnips. Notes and control.
Jones 15–9: notes and illustration of injured mustard leaf.
Cotton 18–281: notes and illustrations of all stages. "the worst insect pest of cabbages in Porto Rico."
at light (343–16); larvae on cabbage (193–12, 194–12, 420–16), at Arecibo (159–19).

Brenthia pavonacella Clemens
Möschler. Gundlach.
adults abundant in coffee grove (431–21 det. Heinrich—"feeds on *Amphicarpaea*"), at Yauco, Adjuntas and Utuado (255–22); resting on morning glory (887–16).

Tortyra auriferalis Walker (?)
Busck.

Choregia aurofasciana Snellen
Möschler. Gundlach.

GRACILARIIDÆ.

Acrocercops sanctaecrucis Walsingham—det. Busck
Cotton 18–300: mining in eggplant leaves. Notes.
larvae mining in leaves of eggplant and *Solanum torvum* (108–16, 525–17, 580–17).

TINEIDÆ.

Ereuntis minuscula Walsingham—det. Busck
larvae under scale insects, *Diaspis pentagona*, on papaya (816–12); feeding on scale insects, *Lepidosaphes beckii*, on grapefruit tree (16–17); a scavenger on old cotton bolls at Humacao (551–21 det. Heinrich), at Fortuna (556–21), at Mameyes (521–22); in dry okra pod at Vega Baja (559–21), in partitions of pods of *Thespesia populnea* at Guayanilla (557–21).

Leucoptera coffeella Stainton
Barrett 04–444; van Leenhoff 04–454; Earle 04– : the coffee leafminer. Notes.
Barrett 05–397: parasitized by *Chrysocharis livida* Ashmead.
Barrett 06–22: parasitized by *Zagrammosoma multilineata* Ash-

mead. *Chrysocharis livida* present throughout the coffee-growing sections.

Van Leenhoff 06–46: severe outbreaks cause shedding of leaves.

Van Zwaluwenburg 15–32: a rather extend account, life-history and unsuccessful control measures.

Van Zwaluwenburg 17–514: Van Z. (602) on coffee.

Wolcott, G. N., "El Minador de las Hojas del Café", Circular No. 52, Insular Experiment Station, Río Piedras, P. R., October, 1921, pp. 1–12, figs. 6.

Wolcott, G. N., "A Reaction to a Variation in Light Intensity by *Leucoptera coffeella*". Ecology, Vol. 3, No. 1, January, 1922, p. 86.

larvae in coffee leaves at Jajome Alto (30–21), at Lares (631–21), common throughout the island wherever the host occurs, an especially serious pest south of Adjuntas.

Amydria sp. near or = **umbraticella** Busck

larvae in rotten underground stem of sugar cane (61–15 det. Busck).

Setomorpha insectella Fabricius—det. Busck

larvae in bottle of paprika (589–12).

Tineola uterella Walsingham—det. Busck

larvae living in flattened cases on walls of houses (162–12).

Opogona sp.—det. Busck

Wolcott 21–37: the Porto Rican Sugar Cane Bud Moth. 1.2% of cane stalks injured by larvae eating eyes. Notes. (Mr. Busck notes: "Probably scavenger, secondary to the injury.")

(642–21), adults on sugar cane (375–16), at Arecibo (656–17) common; larvae attacking eyes of cane at Canóvanas (784–12).

Opogona sp.—det. Busck

larvae scavengers in old leaves of coconut palm previously infested with *Homaledra sabulella* Chambers (596–22).

Pexicnemidia mirella Möschler 89–338, TYPE from Porto Rico. Gundlach.

Tiquadra aspera Zeller

Möschler. Gundlach.

Tiquadra inscitella Walker—det. Busck

pupa in rotten *Erythrina* tree at Cayey (420–22).

Myrmecozela ochraceella Tengstr.

Möschler. Gundlach.

ACROLOPHIDÆ.

Acrolophus vitellus Poey

Busck.

Acrolophus plumifrontellus Clemens
Möschler. Gundlach.
(as sp. — det. Busck) at Guánica (369–14), at light at Guánica (621–13).

Acrolophus walsinghami Möschler 89–336, TYPE from Porto Rico.
Gundlach.

Acrolophus ochracea Möschler (as **Caenogenes**) 89–337, TYPE from Porto Rico.
Gundlach.

Acrolophus popeanella Clemens
(as *Anaphora*) Möschler. Gundlach.
(as *Anaphora* sp. det. Smyth) rare at light (973–16), at Guánica (619–13); larvae dirty brown, spin silken tunnels among trash on ground at Guánica (368–14, 370–14, 520–14, 521–14).

DIPTERA.

LITERATURE.

Roeder, Victor von, "Dipteren von der Insel Porto Rico," etc. Stettiner Entomo. Zeitschrift, 1885, pp. 337–349.

Coquillett, D. W., "Report on a Collection of Dipterous Insects from Porto Rico." Proc. U. S. Nat. Museum, Vol. 22, pp. 249–270. 1900, Washington, D. C.

Aldrich, J. M., "A Catalogue of North American Diptera." Smithsonian Misc. Collections, Part of Vol. 46, No. 1444, pp. 1–680, 1905, Washington, D. C.

Tower, W. V., 12–1 to 23. "A Study of Mosquitoes in San Juan, Porto Rico." Circ. 14, P. R. Agr. Expt. Sta., pp. 1–23, June, 1911. Mayagüez, P. R., 1912.

Tower, W. V., 21—1 to 10. "Mosquito Survey of Mayagüez." Circ. 20, P. R. Agr. Expt. Sta., pp. 1–10. Nov. 2, 1921, Washington, D. C.

The papers of Von Roeder and Coquillett were not available for the preparation of this list, but all their records are given by Aldrich, and when listed here, imply that in addition, they occur in Aldrich's paper. Dr. Aldrich has named practically all the Diptera collected by the workers at the Insular Station, and unless otherwise specified, determination by him is always implied. The writer is also greatly indebted to him for reviewing and suggesting numerous changes and corrections in the first copy of this list. —— Prof. C. L. Metcalf has determined some of the Syrphidae, Mr. W. R. Walton described several of the Tachinidae, Mr. J. R. Malloch has described and determined a considerable number of flies in other families, and Mr. C. T. Greene has made some determinations.

TIPULIDÆ.

Monogoma niveitarsus Alexander, Chas. P., "A Synopsis of Part of the Neo-Tropical Crane-Flies of the Sub-family Limnobinae." Proc. U. S. Nat. Mus. Vol. 44, No. 1966, p. 501, TYPE from Porto Rico. April 30, 1913, Washington, D. C.

Geranomyia rufescens Loew, Hermann, "Beschreibungen einiger neuen Tipularia terricola" *In* Linn. Ent., Vol. 5, p. 396, pl. 2, fig. 9–12. 1851. TYPE from Porto Rico.
Roeder. Gundlach, "El ejemplar típico era de Puerto Rico. Hasta ahora no se ha encontrado en otras islas."

Toxorhina fragilis Loew 51–401, TYPE from Porto Rico.
Roeder. Gundlach, "El tipo era también de Puerto Rico, donde solamente ha sido observado la especie."

Rhamphidia albitarsis Osten Sacken, C. R., "Studies on Tipulidae, Part II." *In* Berlin Ent. Zeitschrift, Vol. 31, p. 184, 1887, TYPE from Porto Rico.

Atarba (Gonomyia) pleuralis Williston
Coquillett. Alexander 13–504.

Eriocera trifasciata Roeder 85–338, TYPE from Porto Rico.
Gundlach, "rara."

Megistocera longipennis Macquart
Roeder. Gundlach, "no es rara."
Alexander, Chas. P., Jour. N. Y. Ent. Soc., Vol. 22, No. 3, Sept. 1914.

Megistomastix portoricensis Alexander, Chas., "A Peculiar New Crane-fly from Porto Rico." *In* Psyche, Vol. 19, pp. 63–66, pl. 1, 1912: TYPE from El Yunque, Porto Rico, 2,800 ft. Feb. 20, 1900, Coll. C. W. Richmond.

Brachypremna unicolor Osten Sacken 87–329, TYPE from Porto Rico.

PSYCHODIDÆ.

Psychoda phalaenoides Linn.
Stahl.

Psychoda albipuncta Williston—det. Aldrich
larvae in dirty water (193–22).

CHIRONOMIDÆ.

Culicoides phlebotomus Williston—det. (?) Aldrich. "jejen."
on the beach at Mameyes, biting man (338–22); at Pt. Cangrejos—det. (?) Johannsen, (GNW).

Ceratopogon punctipennis Williston
Coquillett.

Ceratopogon sequax Williston
Coquillett.

Forcipomyia eriophora Williston—det. Aldrich
sucking juices from larva of *Phlegethontius sexta* Joh. (183–22) and probably this species (84–16, 844–16).

Chironomus redeuns Walker
Coquillett.

Chironomus anonymus Williston
Tower 12–6: at Mayagüez, from water in old pail.

CULICIDÆ.

Anopheles albimanus Wiedemann
Roeder. Gundlach.
Tower 21–6: "the malarial mosquito — in rain-water barrels."

Anopheles grabhami Theobald
Tower 21–6: "legs — very long. The last ankle segment is white and there is a black band next to the claw."

Anopheles punctipennis Say
(as *Corethra*) Roeder. Gundlach.

Megarhinus portoricensis Roeder 85–337, TYPE from Porto Rico.
Gundlach.

Culex bisulcatus Coquillett
Tower 08–38: mention.
Tower 12–6: at Mayagüez, from water in old pail.

Culex pipiens Linn.
Stahl, "zancudo."
Tower 08–38: mention.

Culex quinquefasciatus Say
(as *Culex cubensis* Bigot) Tower 08–38: mention.
Tower 12–6: "the common house mosquito of the tropic".
Van Z. (1729).
Tower 21–5: a short description and notes on habits.

Culex salinarius Coquillett
Tower 08–38: mention.

Culex similis Theobald
Tower 12–6: mention.

Culex toweri Dyar & Knab (TYPE probably from Porto Rico).
Tower 08–38: mention.
Tower 12–6: at Mayagüez, in bamboo pots.

Taeniorhynchus perturbans Walker
Howard, L. O., Bul. 25 (n. s.) Bur. Ent., U. S. Dept. Agr., 1910.

Aedes (Stegomyia) aegypti Linn.
(as *Culex fasciatus* Fabr.) Gundlach.
(as *A. (S.) calopus* Meigen) Van Z. (1728).
Tower 12–6: at Mayagüez, in water tank.
(as *Stegomyia calopus*) Tower 08–38: mention.
Dyar, H. C., Insecutor Inscitiae Menstruus, Vol. 8, No. 10–12, p. 181, 1920.
Tower 21–5: "The Yellow-Fever Mosquito". Notes.

Aedes (Stegomyia) mediovittata Coquillett
Tower 08–38: mention.
Tower 12–6: at Mayagüez, in hollow tree trunks, tin cans and bamboo pots.

Aedes (Taeniorhynchus) portoricensis Ludlow, Can. Ent., Vol. 39, p. 386, 1905. TYPE from Porto Rico.

MYCETOPHILIDÆ.

Mycetophila sp. nov.—det. Knab.
dung-bearing larvae in *Inga laurina* at Aibonito (627–17).

Sciara sp.—det. Knab
larvae in cottony substance secreted by mealybugs on sugar cane (16–12).

Sciara sp.—det. Greene
adults on corn leaves at Aguadilla (29–22, 228–22).

CECIDOMYIDÆ.

Arthrocnodax constricta Felt, E. P., Jour. Ec. Ent., Vol. 9, No. 6, p. 481, December 1914: "from garden beans infested with the common red spider, *Tetranychus bimaculatus*, and probably predaceous thereupon." (479–13 TYPE.)

Karschomyia cocci Felt, E. P., Can Ent., Vol. 45, No. 9, pp. 304–305, 1913: from *Pseudococcus sacchari* Ckll. on sugar cane at Patillas (242–13 TYPE).
Jones 14–461: mention.
Smyth 20–124: probably this species from *Pseudococcus virgatus* Ckll. on cotton. "The adults display the strange habit of hanging in rows festooned on strands of spider-web, where they perform a rocking motion by means of the wings."
reared from *Pseudococcus sacchari* Ckll. (556–16).

Mycodiplosis insularis Felt 13–305: from red spiders, *Caligonus antillarum* sp. nov. Banks, on leaves of *Leonotis neptaefolia* (582–12 TYPE).
reared from same host on leaves of *Asclepias curassavica* (695–12).

Cecidomyia coccidarum Cockerell
Coquillett: "from larvae associated with *Dactylopius (Pseudococcus) citri*——from *Lecanium (Saissetia) hemisphaerica.*"

Cecidomyia coccolobae Cook—det. Stevenson
from small cone-shaped galls on leaves of *Coccolobis pyrifolia* (728–17) and *Coccolobis uvifera* (729–17).

Ctenodactylomyia watsoni Felt
from galls of sea-grape, *Coccolobis uvifera,* in letter of Feb. 9, 1917, by R. H. Van Zwaluwenburg.

Eriophyes calophylli Cook—det. Stephenson
causes a transverse narrow pit-like depression in the leaf surface of *Calophyllum calaba* (730–17) at Espinosa.

Eriophyes cordiae Cook—det. Stevenson
causes irregular fuzzy growths on underside of leaves of *Cordia collococca* (733–17) at Yauco.

Eriophyes guazumae Cook—det. J. A. Stevenson
causes small irregular nodule-like growths on underside of leaves of *Guazuma ulmifolia* (731–17) at Naguabo.

Eriophyes miconiae Cook—det. J. A. Stevenson
causes large irregular fuzzy growths on undersides of leaves of *Miconia* (732–17).

BIBIONIDÆ.

Scatopse pygmaea Loew
Coquillett.
(as sp.) Wetmore 16–71, eaten by hummingbird, *Chlorostilbon mangoci.*

Dilophus sp.
Wetmore 16–73, eaten by hummingbird, *Anthracothorax viridis.*

SIMULIIDÆ.

Simulium haematoptum Malloch—det. Malloch
low hills (69–12, 503–17).

Simulium minusculum Lutz—det. Aldrich
abundant in the spring (212–22).

Simulium quadrivittatum Loew
Wetmore 16–66, eaten by P. R. Tody, *Todus mexicanus.*
clearing in the woods (214–13 det. Malloch), near coffee grove (GNW det. Johannsen).

STRATIOMYIDÆ.

Hermetia albitarsis Fabr.
(as *H. sexmaculata*) Macquart, J., Hist. Nat. Dipt., Paris, 1834, Vol. 1, p. 229.

Hermetia illucens Linn.
Stahl. Roeder. Gundlach, "se posa muchas veces sobre los troncos de los árboles recién cortados." Coquillett.
Van Z. (P. R. 108).
(258–12, 267–12, 471–12, 316–12, 767–12, 77–13, 747–14, 377–16, 562–17); at Guánica (639–13, 427–14); larvae breeding in "cachaza" filter-press cake (594–17).

Sargus bicolor Wiedemann, C. R. W., Aussereuropaische Zweiflügelige Insekten, Vol. 2, p. 41, 1830.

Macrosargus lateralis Macquart—det. Greene
in grapefruit grove (554–17).

Macrosargus sp.—det. Greene
(622–12, 850–16, 553–17); at Aibonito (SSC).

Neorondania chalybea Wiedemann—det. Knab
Van Z. (P. R. 1244) from *Spondias lutea.*
larvae beneath stinking, flaking bark of dying papaya, *Carica papaya,* tree (843–12); from banana stem (770–16);

Odontomyia dorsalis Fabr.
Coquillett.

TABANIDÆ.

Chrysops costatus Fabr.
Stahl. Roeder. Gundlach "muy común en terrenos bajos, donde suele posarse encima de las orejas de los caballos para chupar la sangre por lo cual es insecto muy molesto."
Van Z. (P. R. 100).
at Pueblo Viejo (161–15, 175–15, 184–15), Añasco (1028–13).

Tabanus psamophilus O. S.—det. Greene
on the beach, resting on dry seaweed, as which it is the same color, and in which its larvae live, feeding on sand fleas, at Pt. Cangrejos (114–15), at Vega Baja (493–16).

LEPTIDÆ.

Chrysopila sp.—det. Greene
on the beach at Pt. Cangrejos (GNW).

BOMBYLIDÆ.

Hyperalonia cerberus Fabr.
(as *Exoprosopa*) Stahl. Roeder.
Gundlach "muy común en terrenos desmontados" (brushy land).
on the beach at Santurce (602–17) and at Pt. Cangrejos; on brushy hill north of Ponce (113–13).

Hyperalonia servillei Macquart
Coquillett.

Heterostylum ferrugineus Fabr.—det. Knab
(592–12, 627–12).

Exoprosopa cubana Loew
Roeder. Gundlach, "rara."

Anthrax adusta Loew—det. Greene
at Guánica (424–13)

Anthrax bigradata Loew
Roeder. Gundlach.

Anthrax faunus Fabr.
Roeder. Gundlach.

Anthrax gorgon Fabr.
Roeder. Gundlach. Coquillett.
from cocoons of *Elis haemorrhoidalis* Fabr. at Plantaje, Pt. Salinas (64–22, 64A–22 det. Greene).

Anthrax lucifer Fabr.
Stahl. Roeder. Gundlach, "común — suele posarse en el suelo". Van Z. (P. R. 78).
at Guánica (423–13 det. Greene).

Anthrax oedipus Fabr.
Gundlach.

Anthrax paradoxa Jaennicke
Osten Sacken, Biologia Centrali-Americana, Dipt. Vol. 1, p. 120, 1886.
Roeder. Gundlach.

THEREVIDÆ.

Psilocephala argentata Bellardi
Roeder.

Thereva argentata Bellardi
Roeder. Gundlach, "rara."

ASILIDÆ.

Leptogaster cubensis Bigot
Roeder. Gundlach, "rara."

Atomosia incisuralis Macquart
Van Z. (P. R. 1206).
unlabeled specimens, probably from Guánica.

Ommatius marginellus Fabricius, Spec. Ins., II, 464; Ent. Syst., 384 (*Asilus*); Syst. Antl., 170 (*Dasypogon*).
Gundlach. Van Z. (P. R. 107).

Proctacanthus lutescens Loew
Stahl.

Proctacanthus rufiventris Macquart
Roeder. Coquillett. Gundlach.
Wolcott 22d-16: "quite common."
common (561-17, 79-10, 17-14) carrying a large grasshopper at Isabela (GNW) and at Pt. Cangrejos (GNW).

Erax bastardi Macquart
Roeder. (as *Erax femoratus* Macq.) Gundlach.

Erax rufitibia Macquart
Roeder. Gundlach. Van Z. (det. Knab).

DOLICHOPODIDÆ.

Psilopus caudatus Wiedemann—det. Aldrich

Psilopus ciliipes Aldrich—det. Aldrich
(37-17), in grape-fruit grove at Vega Alta (107-17).

Psilopus chrysoprasius Walker
Roeder. Gundlach.

Psilopus diffusus Wiedemann
Roeder. Gundlach.

Psilopus mundus Wiedemann
(as *Psilopus ciliatus* Loew, det. Aldrich) at Corozal

Psilopus jucundus Loew
Roeder.

Psilopus longicornis Fabr.
Coquillett.

Psilopus pilosus Loew
Roeder. Gundlach.

Psilopus portoricensis Macquart, Hist. Nat. Dipt., I, 450; Dipt. Exot. II, 2, 121; Suppl., 1, 120, pl. XI, f. 17.

Psilopus suavium Walker
Roeder. Gundlach.

Psilopus dimidiatus Loew
Roeder. Gundlach.

Psilopus psittacinius Loew
Roeder. Gundlach.

Mesorhaga albiciliata Aldrich—det. Aldrich
at Guánica (458-14).

Chrysotus barbatus Loew
(as *Syntormon*) Coquillett.

Chrysotus pallipes Loew
Roeder. Gundlach. Coquillett.

Paraclius filifer Aldrich
Coquillett, from Vieques Id.

Pelastoneurus fasciatus Roeder 85–340, TYPE from Porto Rico.
Gundlach, "observado solamente en Puerto Rico".

EMPIDIDÆ.

Drapetis flavida Williston
Coquillett.

Hybos subjectus Walker = **H. triplex** Walker
Coquillett.

PHORIDÆ.

Aphiochaeta aurea Aldrich
Coquillett.

Aphiochaeta macrochaeta Malloch
Van Z.

Aphiochaeta picta Lehmann—det. Aldrich
from dead *Belostoma* adults (1049–16).

Aphiochaeta subflava Malloch
Van Z.

Aphiochaeta scalaris Loew—det. Malloch
from dead May-beetle at Fajardo (526–12), from dead termites (163–21 det. Greene); from dead insects (1049–16, 1050–16).

Conicera aldrichii Brues
Wetmore 16–74, eaten by hummingbird, *Anthrocothorax aurulentus.*

Dohrniphora venusta Coquillett—det. Greene
from dead termites, *Nasutitermes morio* Latr., (126–21); from decaying bean pods (590–17—det. Malloch); from dead insects (1051–16).

Puliciphora borinquensis Wheeler, Wm. M., "A New Wingless Fly from Porto Rico," Bull. 12, Amer. Mus. Nat. Hist., Article 14, pp. 267–271, pl. 34, 1906.

SYRPHIDÆ.

Baccha capitata Loew
Roeder. Gundlach. Van Z. (5035) on *Aphis* sp.
with *Saissetia hemisphaerica* Targ. at Comerío (883–13).

Baccha clavata Fabricius
Roeder. Gundlach. Coquillett. Van Z. (P. R. 88).
Wolcott 22–7: short account, life-history, predaceous on aphids. Illustrations of larva, puparium and adult.
larvae feeding on aphids on okra (573–12), on *Aphis nerii* Boyer on milkweed (438–12), on *Toxoptera aurantiae* Boyer on grape-fruit (234–17), on *Aphis gossypii* Glover on cucumber (65–16), on *Macrosiphum illinoiensis* Shimer on *Cissus sicyoides* (429–21).

Baccha parvicornis Loew
Roeder. Gundlach.
apparently from nymphs of a Fulgorid, *Ormenis pygmaea* Fabr., on coffee leaf (190–21); from white-flies on *Inga laurina* in plaza at Cabo Rojo (505–18); from leaf of *Erythrina glauca* infested with mealybugs, *Pseudococcus nipae* Mask. (70–23).

Baccha (Ocyptamus) conformis Loew
Roeder. Gundlach. Van Z. (P. R. 1207).

Baccha (Ocyptamus) fasciatus Roeder 85–342, TYPE from Porto Rico.
Gundlach, "observado solamente en Puerto Rico."
larvae feeding on aphids, *Toxoptera aurantiae* Boyer, on coffee, mountains north of Yauco (413–21), on *Aphis nerii* Boyer on milkweed at Yauco (59–22).

Baccha (Ocyptamus) latiusculus Loew
Roeder. Gundlach. Coquillett.
(as *Ocyptamus* sp.) Jones 15b–14: description of stages, as predator on *Sipha flava* Forbes on sugar cane. Colón 19–29.
larvae feeding on aphids, *Toxoptera aurantiae* Boyer, on grapefruit (38–17, 109–17, 392–12), on coffee in mountains north of Yauco (413–21); on *Sipha flava* Forbes on sugar cane (662–12); on *Aphis nerii* Boyer (438–12), at Yauco (56–22); on *Aphis gossypii* Glover on cucumbers (78–16); on *Aphis maidis* Fitch on corn (799–17).

Baccha stenogaster Williston—det. Greene
from mealybugs, *Phenacoccus gossypii* T. & C., on cotton at Maunabo (72–22).

Toxomerus arcifer Loew
Coquillett. Van Z. (P. R. 109).
swept from grass (76–12), at Manatí and Corozal (GNW).

Toxomerus aurulentus Williston—det. Greene
from Aibonito (SSC).

Toxomerus basilaris Wiedemann—det. Metcalf
swept from grass at Coloso, Caguas, Manatí, and Pt. Cangrejos (GNW).

Toxomerus boscii Macquart
(as *Mesograpta*) Stahl. Roeder. Gundlach.

Toxomerus politus Say—det. Cotton
Cotton 18–291: "Corn Feeding Syrphid Fly"—"very abundant on corn and some of the native wild grasses. The yellowish colored grubs feed on pollen grains and on the saccharine cells in the axils of the leaves. The grubs pupate between the stalk and the leaf-sheath. —parasitic enemies numerous."
larvae feeding on pollen of corn (578–17, 597–17).

Toxomerus polygonastyla sp. nov., ms. name of C. P. Metcalf, "because of the peculiar shape of the styles on the male".
puparia common on tobacco at Cayey (114–21), larvae possibly feed on small insects becoming stuck on leaves.

Toxomerus laciniosus Loew
Roeder. Gundlach. Coquillett.
common, swept from grass at Caguas, Ciales, and Manatí—det. Metcalf (GNW).

Toxomerus minutus Wiedemann
(as *Mesograpta*) Gundlach, "rara en Puerto Rico."

Toxomerus subannulatus Loew
Coquillett.
larvae on cane infested with *Sipha flava* Forbes (732–12); feeding on *Rhopalosiphum persicae* Sulz. on peppers (34–17); adults swept from grass at Caguas and Ciales (GNW).

Allograpta limbata Fabr.—det. Greene
larvae on cane infested with *Sipha flava* Forbes (710–12); larvae and pupae in arrows of sugar cane (81–19, 127–22, 60–23), at Cidra (29–21).

Volucella esuriens Fabr.
Roeder. Gundlach.

Volucella obesa Fabr.
Stahl. Roeder. Gundlach, "sumamente común en los montes."
Van Z. (P. R. 92).
at Añasco (1009–13), at Naguabó (734–14).

Volucella pallens Wiedemann
(as *V. sexpunctata* Loew) Stahl. Roeder. Gundlach.
Van Z. (P. R. 1204).
on flowers of *Cordia* (645–12, 225–13 det. Greene).

Volucella pusilla Macquart
Roeder. Gundlach.

Eristalis atrimanus Loew—det. Greene
on *Cordia* flowers (644–12), on flowers near the beach at Pt. Cangrejos (605–17); resting on cane at Yauco (238–21).

Eristalis albifrons Wiedemann
Roeder. Gundlach.
(as *E. albiceps*) Wetmore 16–87, 89, 99; eaten by swallow, martin and Redstart.

Eristalis pusio Wiedemann
Roeder. Gundlach.

Eristalis vinetorum Fabr.
Stahl. Roeder. Gundlach.
Van Z. (P. R. 96).
on flowers at Aibonito (574–16), at Arecibo (442-13), at Añasco (1027–13), at Ponce (116–13).

Meromacrus (Pteroptila) cinctus Drury
Roeder. Gundlach.
Van Z. (P. R. 616).

Meromacrus (Pteroptila) pratorum Fabr.
Roeder. Gundlach.

Xylota pachymera Loew
Roeder. Gundlach.

CONOPIDÆ.

Conops pictus Fabr.
Roeder. Gundlach.

Zodion nanellum Loew
Roeder. Gundlach.

TACHINIDÆ.

Gymnosoma filiola Loew = **G. fuliginosa** Desvoidy
Roeder. Gundlach.

Compsilura oppugnator Walton, W. R., "Four New Species of Tachindae from North America" *In* Proc. Wash. Ent. Soc., Vol. 16, No. 2, pp. 93–95, June, 1914: from *Cirphis latiuscula* H. S. (88–12 TYPE).
Jones 14–462; Jones & Wolcott 22–44.
(88–12).

Trichopoda flava Roeder 85–343, TYPE from Porto Rico.
Gundlach, "Parece ser propia de la isla."

Trichopoda pennipes Fabr.
(as *T. pyrrhogastra* Wied.) Roeder. Gundlach.
(as *T. pyrrhogaster* Wied.) Van Z. (P. R. 104).

Cryptomeigenia aurifacies Walton, W. R., "A New Species of Tachinidae from Porto Rico" *In* Proc. Ent. Soc. Wash., Vol. 14, No. 4, pp. 198–200, pl. x, Jan. 10, 1912.

(as sp.) Van Dine 12–18.

Van Dine 13–29; Van Dine 13–254; and Van Dine 13a–37: the latter the more complete account of rearing this parasite of *Lachnosterna* beetles from Añasco.

Van Z. (P. R. 5060).

Smyth 17–56, 86 to 87, 151: "The number of pupae found within one dead adult host varies from two to nine, usually four to six. Infested beetles that have died are always found in their burrows in the ground." Illustrations of adult and empty puparium.

Colon 19–50.

from adults of *Lachnosterna vandinei* Smyth and *L. portoricensis* Smyth at Añasco (356–12 TYPE, 519–12), at Pueblo Viejo (909–14), and generally throughout the moister portion of the island.

Hypostena vanderwulpi Townsend

Coquillett.

Euzenilliopsis diatraeae Townsend—det., adults by Aldrich, pupae by Greene.

(as *Tachinophyto* sp.) Van Dine 13–254; Van Dine 13–29: parasite of *Diatraea saccharalis* Fabr.

(as *Hypostena* sp.) Van Dine 12–17. Jones 15c–15.

(as *Tachinophyto* sp.) Van Z. (P. R. 5019) from *Diatraea saccharalis* Fabr.

(as *Tachinophyto* sp. and *Hypostena* sp.—not in synonymy) Colón 19–41 and 42.

pupae found in tunnels of *Diatraea saccharalis* Fabr. (175–11, 217–11, 208–12, 904–13) reared from larvae of *Diatraea* (630–17, 694–17).

Eutrixoides jonesii Walton, W. R., "New North American Tachinidae (Diptera)" *In* Ent. News, Vol. 24, No. 2, pp. 49–52, pl. 1, Feb. 1913.

Van Dine 13–254; Van Dine 13–29 and Van Dine 13a–37: the latter the more complete account.

Smyth 17–56 and 151.

Colón 19–51.

from adults of *Lachnosterna vandinei* Smyth and *L. portoricensis* Smyth in the moister portions of the island, at Añasco (454–12 TYPE, 483–12, 504–12), less abundant than *Cryptomeigenia aurifacies.*

Leskia analis Say

Van Z. (P. R. 5055) from *Diaphania hyalinata* Linn.

Belvosia bifasciata Fabr.
Stahl. Roeder. Gundlach.
from pupae of *Herse cingulata* Fabr. at Hatillo (518–18).

Belvosia luteola Coquillett 00–253: TYPE from Vieques Id.

Belvosia piurana Townsend—det. Townsend
on flowers (639–12).

Ocyptera atra Roeder 85–344, TYPE from Porto Rico.
Gundlach.

Ocyptera minor Roeder 85–344, TYPE from Porto Rico.
Gundlach.

Nemorilla maculosa Macquart = **Exorista pyste** Walker—det. Aldrich.
from pupa of *Diaphania hyalinata* Linn. (489–16).

Exorista amplexa Coquillett—det. Aldrich
from larvae of *Ecpantheria eridanus* Cramer (560–16).

Euphorocera claripennis Macquart—det. Walton
Jones & Wolcott 22–49.
from larvae of *Remigia repanda* Fabr. at Santa Isabel (7–12).

Exorista tassellata Roeder 85–345, TYPE from Porto Rico
Gundlach.

Frontina aletiae Riley—det. Aldrich
from larva on *Inga laurina* at Lares (58–22).

Frontina archippivora Williston—det. Walton
Van Dine 13–31; Van Dine 13–257; Jones 13–235; Jones & Wolcott 22–47: as parasite of *Laphygma frugiperda* S. & A.
from *Laphygma frugiperda* S. & A. (74–12, 83–12, 84–12, 90–12, 738–12, 558–17, 585–17, 609–17), at Mameyes (822–12), at Arecibo (216–11), from pupa at Sabana Grande (444–21).

Frontina ruflfrons Roeder 85–346, TYPE from Porto Rico.

Zygosturmia sp.—det. Aldrich
from Sphinx larva on *Cordia* (473–13).

Sturmia (Argyrophylax) albincisa Wiedemann — det. Walton & Townsend.
Cotton 17–113: from larvae of *Pachyzancla periusalis* Walker on tobacco.
Colón 19–36.
from larvae of *Pachyzancla periusalis* Walker (215–12, 797–16, 798–16, 957–16, 968–16, 88–19); from pupa of *Zinckenia perspectalis* Fabr. (1132–16); from *Nacoleia indicata* Fabr. (38–12); from *Mesoncondyla concordalis* Hübner (741–14).

Linnaemyia fulvicauda Walton 14–93, TYPE from Porto Rico.
Jones 14–462; Jones & Wolcott 22–49: from *Remigia repanda* Fabr.
from *Remigia repanda* Fabr. (109–12 TYPE), at La Plata, Cayey (131–12), at Aibonito (SSC).

Blepharipeza jurinioides Townsend—det. Aldrich
(unlabeled specimens.)

Blepharipeza leucophrys Wiedemann
Gundlach.
(many unlabeled specimens, poss. from dead mouse (759–17).)

Parachaeta bicolor Macquart
(unlabeled specimens, poss. from dead mouse (759–17).)

Winthemia quadripustutata Fabr.—det. Aldrich
from pupa of Noctuid on sugar cane at Ponce (144–12).

Gonia sp.—det. Aldrich
from *Anticarsia gemmatilis* Hübner (877–14, 878–14).

Gonia angusta Macquart
Van Z. (P. R. 103) from *Lachnosterna* spp.

Gonia crassicornis Fabr.
Van Dine 13–31; Van Dine 13–257; Jones 13–235; Jones & Wolcott 22–47: from *Laphygma frugiperda* S. & A.
(450–12, 559–12); from *Laphygma frugiperda* S. & A. at Arecibo (8–12).

Gonia pallens Wiedemann
Roeder.
(as *Gonia chilensis* Macq.) Gundlach.
from *Xylomiges sunia* Guenee (762–16, 819–16).

Peleteria robusta Wiedemann
(as *Echinomyia*) Roeder. Gundlach.

Archytas analis Fabr.
from cutworm on tobacco at Aibonito (187–12).

Archytas basifulva Walker
Coquillett. Van Z. (P. R. 97).

Archytas piliventris V. d. Wulp—det. Walton
Van Dine 13–31; Van Dine 13–257; Jones & Wolcott 22–47; from *Laphygma frugiperda* S. & A.
from pupa of *Laphygma frugiperda* S. & A. (117–12, 558–12).

Archytas (Nemochaeta) seminigra Wiedemann
(as *Jurinia analis* Macq.) Roeder. Gundlach.

DEXIIDÆ.

Phorostoma (Paramyiocera Rhynchodexia) rufianalis V. d. Wulp
Coquillett.
in citrus grove at Pt. Salinas (178–15); on flowers at Pt. Cangrejos (603–17).

Dexia strenua Desvoidy
Roeder. Gundlach.

SARCOPHAGIDÆ.

Sarcophagula occidua Fabr.
Coquillett.
on cattle dung (745–12—det. as *S. imbecilla* V. d. Wulp by Knab), from weeds (24–17), on corn leaves (257–21).

Sarcophaga amoena Aldrich—det. Aldrich
(398–13), on leaves of corn (646–17); reared from injured snail from Lares (76–22).

Sarcophaga bakeri Aldrich
Aldrich, J. M., "Sarcophaga and Allies in North America." Thomas Say Foundation, Lafayette, Ind., 1916, p. 270.
on weeds (215–17) and from Mayagüez (Van Zwaluwenburg, Coll.).

Sarcophaga capitata Aldrich 16–209, TYPE from Porto Rico, at Mayagüez and Arecibo.
(243–17).

Sarcophaga culminata Aldrich 16–289, TYPE from Porto Rico, at Mayagüez.

Sarcophaga diversipes Coquillett 00–255, TYPE from Porto Rico.

Sarcophaga lambens Wiedemann
Roeder. Gundlach. Coquillett.

Sarcophaga helicis Townsend
(as *Helicobia*) Coquillett. Jones & Wolcott 22–49:
from larva of *Remigia repanda* Fabr. at La Plata, Cayey (123–12).

Sarcophaga peltata Aldrich 16–216, TYPE from Porto Rico, at Naguabo and Mayagüez.
common among weeds (19–17), around grapefruit trees (559–17), on corn leaves (255–21).

Sarcophaga plinthopyga Wiedemann
Roeder. Gundlach. Coquillett.

Sarcophaga quatrisetosa Coquillett
Parker, Proc. Boston Soc. N. H., Vol. 35, p. 60 (as *Ravenia*).

Sarcophaga robusta Aldrich
Aldrich 16–268: from Mayagüez, P. R.
Jones & Wolcott 22–49: from pupae of *Remigia repanda* Fabr. and from white grubs.
(452–12, 766–12, 717–14), from dead spider (5–14); from dead *Lachnosterna* beetles (472–12, 702–16), at Añasco (400–12, 445–12, 446–12, 453–12, 467–12, 488–12), at Guánica (547–13); from grubs of *Lachnosterna portoricensis* Smyth (735–17); from pupae of *Remigia repanda* Fabr. at Guánica (657–14), at Mameyes (812–12); five adults from one pupa of *Laphygma frugiperda* S. & A. (557–17); from sphinx moth larva at Yauco (410–21); from pupae of *Alabama argillacea* Hübner at Hatillo (213–22, 214–22); from dead sphinx moth at Caguas (SSC); from dead changa, *Scapteriscus vicinus* Scudd. at Patillas (1206–13); from dead cockroach (627–21). Adults at Toa Baja (140–13), at Añasco in coffee grove (348–13), swept from grass at Morovis (GNW).

MUSCIDÆ.

Cochliomyia (Paralucilia Chrysomyia) macellaria Fabr.
(as *Chrysomyia*) Roeder. Gundlach. Coquillett. Van Z. (P. R. 1214).
Stevenson 18–150: host for fungus, *Cordyceps dipterygena* Berk. & Br.
on dung (20–17), on grapefruit tree at Vega Alta (116–17), on leaves of corn at Aguadilla (227–22), at Fajardo (394–21); attracted to gasoline (736–17).

Ormia punctata Desvoidy
Roeder. Gundlach.
at Pt. Cangrejos (GNW); at Aibonito (575–16 det. Aldrich).

Lucilla caesar Linn.
Coquillett.

Lucilla ruficornis Macquart
Roeder. Gundlach, "común."

Lucilla semiviolacea. Bigot, J., "Dipteres noveaux ou peu connus." *In* Annales Soc. Ent. France, No. 9, pt. 7, 1877, p. 46: TYPE from Porto Rico (as *Somomyia*).

Pyrellia ochricornis Wiedemann.
Stahl. Roeder. Gundlach. Coquillett.
on dung (21–17), in citrus grove at Vega Alta (117–17); larvae in wet decaying vegetation (436–17).

Pyrellia scapulata Bigot
on corn leaves (254–21), on underside of coffee leaves (267–21).

Parapyrellia (Morellia) violacea Fabr.
(as *Pyrellia centralis* Loew) Roeder. Gundlach.
(as *Pyrellia*) Wetmore 16–84: eaten by Wood Pewee, ***Blacicus blacoi.***
in coffee grove at Ciales (GNW).

Musca domestica Linn.
Stahl. Roeder. Gundlach. Coquillett. Van Z. (1717).
(151–11), larvae in rotten palm tree from Añasco (116–22).

Synthesiomyia nudiseta V. d. Wulp = **S. grasiliana** B. & B.—det. Aldrich.
(430–12, 347–17.)

Stomoxys calcitrans Linn.
Roeder. Gundlach. Coquillett. Van Z. (1727) on cattle.
(18–17, 23–17.)

Haematobia irritans Linn.
(as *Hyperosia*) Van Z. (1711) attacks cattle.
(as *H. serrata* Desv.) Merrill 15–53 to 55: life history and bionomics in P. R., parasites, predators and comensals of larvae.
(as *H. serrata* Rob. Desv.) Colón 19–34 and 35: summary.
(as *H. serrata*) Smyth, E. G., "La Mosca del Ganado (the Horn Fly)" Circ. 39, Insular Expt. Sta., pp. 1–17, pl. 4, February 1912: a compilation of remedies.
(as *H. serrata* Desv.) Wolcott 22d–18: a short account, comensals with and parasites of larvae in P. R.
Common on dry (southern) side of the Island, less abundant on the moist (northern) side, breeding in fresh cattle dung, adults attacking cattle.

Neomuscina tripunctata V. d. Wulp = **N. cavicola** Townsend
(as *Muscina*) Coquillett.

ANTHOMYIDÆ.

Atherigona pulvinata Grimshaw
reared from decaying eggplant (129–16).

Ophyra aenescens Wiedemann
Roeder. Gundlach.

Limnophora arcuata Stein
Coquillett.

Limnophora corvina Giglio–Tos
swept from weeds (25–17).

Coenosia varicornis Coquillett 00–256, TYPE from Porto Rico.

Lispa rufitibialis Macquart
Coquillett.

Fucellia maritima Haliday
(as *F. fucorum* Fallen) Howard, L. O., Proc. Wash. Acad. Sci., Vol. 2, p. 599.

Bithoracochaeta despecta Walker
swept from grass at Corozal (GNW).

SCATOPHAGIDÆ.

Scatophaga exotica Wiedemann
Coquillett: from Culebra Id.

BORBORIDÆ.

Limosina fontinalis Fallen
Coquillett.

Limosina lugubrina Malloch, J. R., "Descriptions of New Species of American Flies of the Family Borboridae" Proc. U. S. Nat. Mus., Vol. 44, No. 1958, pp. 361–372, Feb. 20, 1913, Washington, D. C. TYPE from Porto Rico.

Limosina perparva Williston
Coquillett.

Limosina lugubris Williston
Coquillett.

Limosina rotundipennis Malloch 13–361, TYPE from Porto Rico.

Limosina venalicia Osten Sacken
Coquillett.

Limosina viveipennis Malloch 13–361, TYPE from Porto Rico.

SCIOMYZIDÆ.

Sepedon macropus Walker
Roeder. Gundlach.

SAPROMYZIDÆ.

Lonchaea longicornis Williston
Coquillett.

Lonchaea glaberina Wiedemann
Van Z. (P. R. 1664) from pods of *Inga vera.*

Lonchaea chalybea Wiedemann
Barrett 04–447: on *Manihot utilissima* and *M. palmata.*
Barrett 05–396: larva "a serious pest in the tips of cassava canes." Handpicking and tobacco dust in dry seasons as control.
larvae in terminal shoots of cassava at Manatí (157–13); a common, and at times, a serious pest, reported by Agr. Agents at Sabana Grande and Aguadilla.

Physogenua ferruginea Schiner
in coffee groves at Lares (391–21), at Ciales (GNW).

Physogenua cittata Macquart
(as *Lauxania variegata* Loew) Stahl. Roeder. Gundlach.

Lauxania albovittata Loew
Roeder. Gundlach.

Sapromyza cincta Loew
Roeder. Gundlach.

Sapromyza octopunctata Wiedemann
Roeder. Gundlach.
swept from grass at Morovis (GNW).

Sapromyza sordida Wiedemann
Coquillett.

Sapromyza valida Walker = **S. macula** Loew—det. Aldrich
(1042–16.)

Trigonometopus sp. nov.—det. Aldrich
resting on coffee leaf in mountains north of Yauco (242–22).

ORTALIDÆ.

Tetanops sp.
Wetmore 16–66: eaten by Tody, *Todus mexicanus.*

Ortalis quadrivittata Macquart
Stahl.

Acrosticta apicalis Williston—det. Aldrich
resting on corn (257–21).

Euxesta annonae Fabr.
Roeder. Gundlach. Van Z. (det. Knab).

Euxesta apicalis Williston
Coquillett.

Euxesta costalis Fabr.
Roeder. Gundlach.

Euxesta spoilata Loew
Roeder. Gundlach. Coquillett.

Euxesta stigmatias Loew
Roeder. Gundlach. Coquillett.

Euxesta thomae Loew
Coquillett.
Wolcott 21–42: common in cane fields, around cane cars and on human feces. Illustration of adult.
adults on stems of *Agati grandiflora* at Añasco (1101–13) at Aibonito (SSC), at Manatí, Coloso, Guánica and Patillas (GNW).

Stenomacra guerini Bigot
Roeder. Gundlach.

TRYPETIDÆ.

Toxotrypana curvicauda Gerstaecker
Hooker 13–36: "Abundant at Mayagüez. —The eggs are laid well below the surface of the green fruit (of papaya, *Carica papaya*); 2 to 15 or more larvae mature within the fruit, and when it drops, pupate 1 or 2 inches below the surface of the ground below the fruit. Adults emerge in 17 to 21 days, and eggs for another brood are soon laid."
Van Z. (1243) in *Carica papaya*.

Anastrepha fraterculus Wiedemann—det. Bezzi for Hooker.
(as *Acrotoxa*) Roeder. Gundlach.
(as *A. acidusa* Walker) Tower 12–34 and 35: in fruit of imported mangoes, especially the Cambodiana variety. Life history.
Hooker 13–36: "in one of the native mangoes (mango de puerco) —in guava (*Psidium guajava*), jobo amarillo (*Spondias lutea*), and jobo de la India fruit. —The larvae in (the fruit of) jobo (*Spondias lutea*) are commonly attacked by two hymenopterous parasites, *Opius (Utetes) anastrephae* n. sp. (Viereck) and *Ganaspis* n. sp. (det. Crawford)."
Van Z. (1202) in guayaba, mango, *Spondias lutea*.
Van Zwaluwenburg 18–34: "a heavy infestation — near Maricao in July (1917) in pomarosa fruits, *Eugenia jambos*."
adults resting on grapefruit (555–17), on corn leaf (253–21), on coffee leaf (264–21); larve from fruit of guava, *Psidium guajava*, at Ciales (893–13); from fruit of jobo, *Spondias lutea*, (67–16), from mango, *Mangifera indica*, (305–12).

Polymorphomyia bascilica Snow—det. Aldrich
from elongate gall on stem of *Eupatorium odoratum* (39–17).

Aciura insecta Loew
Roeder. Gundlach.
Wolcott 21–42: adults resting on cane leaves at Coloso, Aguada, Camuy, Arecibo, Manatí and in "hills of north and west coast" of the Island.
resting on corn leaves (502–17), at Aguadilla (226–22).

Ensina humilis Loew
Roeder. Gundlach.
Wolcott 21–42: adults resting on cane at San Sebastián, Manatí, Corozal and other localities in "hills of north and west coast" of the Island.

Ensina perigrina Loew
Coquillett.

Euaresta melanogaster Loew
Roeder. Gundlach.
resting on grapefruit at Vega Alta (231–17) swept from grass in coffee grove at Ciales (68–21), and at Caguas (GNW).

Euaresta mexicana Wiedemann
Van Z. (P. R. 106).

Urellia solaris Loew—det. Aldrich
common on malojillo, *Panicum barbinode,* grass at Pt. Cangrejos and on cane at San Sebastián (GNW).

MICROPEZIDÆ.

Nerius cinerius Roeder 85–348, TYPE from Porto Rico.

Micropeza limbata Roeder 85–347, TYPE from Porto Rico.
Gundlach.

Calobata fasciata Fabr.
(as *Taeniptera*) Stahl.
Roeder. Gundlach, "común".
Coquillett, (on human excrement, Howard).

Calobata lasciva Fabr.
(as *Taeniptera*) Stahl.
Roeder. Gundlach. Coquillett. Wolcott 21–41: "common in cane fields—reared from old cane stalks." Illustration of adult.
adults on cane leaves at Arecibo (187–11), at Manatí (65–15), at Toa Alta (452–21), at San Sebastián, Guayanilla (GNW); reared from larvae in decaying cane cuttings (124–12) and in dry cane stalk (2–21).

Calobata sp.
Adults with chestnut-red head and thorax, black abdomen, wings clear except for distal angle and medio-distal quarter.
at Vega Alta 105–17); in coffee groves in mountains at Ciales (461–21), at Utuado (479–21) and at Adjuntas (90–22).

SEPSIDÆ.

Sepsis discolor Bigot
Roeder. Gundlach, "muy rara".

Sepsis insularis Williston
Coquillett.

EPHYDRIDÆ.

Notiphila erythrocera Loew
Roeder. Gundlach.

Notiphila virgata Coquillett 00–259, TYPE from Porto Rico.

Paralimna decipens Loew
Coquillett.

Paralimna obscura Williston
Coquillett.

Ptilomyia enigma Coquillett 00-261, TYPE from Porto Rico.

Allotrichoma abdominalis Williston
Coquillett.

Psilopa aciculata Loew
Coquillett.

Psilopa mellipes Coquillett 00-260, TYPE from Porto Rico.

Psilopa nigrimana Williston
Coquillett.

Ilythea flavipes Williston
Coquillett.

Ilythea ? oscitans Walker (*Ephydra*)
Coquillett.

Athyrolossa nitida Williston
Coquillett.

Discocerina leucoprocta Loew
Coquillett.

Discocerina parva Loew
Coquillett.

Hydrellina glivipes Coquillett 00-261, TYPE from Porto Rico.

OSCINIDÆ.

Chlorops trivittata Williston
Coquillett.

Hippelates apicata Malloch, J. R., "The Genera of Flies of the Subfamily Botanodiinae with hind tibial spur." Proc. U. S. Nat. Mus. Vol. 46, No. 2024, pp. 242-255. Dec. 6, 1913, Washington, D. C., TYPE from Porto Rico, p. 248.

Hippelates convexus Loew
Coquillett. Malloch 13-249.

Hippelates flavipes Loew
Coquillett. Van Z. (1712).
(1054-16).

Hippelates nudifrons Malloch 13-242, TYPE from Porto Rico.

Hippelates pusio Loew
Coquillett.

Hippelates peruanus Becker
Malloch 13–244.

Hippelates tener Coquillett
Malloch 13–255.

Hippelates texanus Malloch—det. Aldrich
Wolcott 21–42: "'Mimis'—abundant on cane at Guánica—often in great abundance in cane fields at many other places in the dryer parts of Porto Rico."
Annoying to man and animals, buzzing about and resting on ears, nose, mouth and eyes.

Pseudogaurax lancifer Coquillett, 00–265, TYPE from Porto Rico: reared from egg-sacs of spiders.
from eggs of spider, *Gasteracanthia cancriformis* Linn. (333-21) and at Pt. Cangrejos (GNW).

Oscinis anonyma Williston
Coquillett.

Oscinis coxendix Fitch
Coquillett.

Oscinis nana Williston
Coquillett.

Oscinis obscura Coquillett 00–266, TYPE from Porto Rico.

Oscinis quadrilineata Williston
Coquillett.

Oscinis umbrosa Loew
Coquillett.

Oscinis virgata Coquillett
Coquillett.

DROSOPHILIDÆ.

Sigaloessa bicolor Loew
Coquillett.

Drosophila funebris Fabr.
Coquillett.

Drosophila fusca Coquillett 00–264, TYPE from Porto Rico.

Drosophila melanogaster Meigen
Van Z. (P. R. 110).
in decaying oranges (599–16).

Drosophila vittata Coquillett
Coquillett.

Drosophila sp.—det. Aldrich
from ovary of flower of "tibey", *Isotoma longiflora*, (490-21).

Stenomicra angustata Coquillett 00-262, TYPE from Porto Rico.

Cladochaeta nebulosa Coquillet 00-263, TYPE from Porto Rico.

GEOMYZIDÆ.

Anthomyza nigrimanus Coquillett

AGROMYZIDÆ.

Agromyza aeneiventris Fallen
Coquillett.
"probably *caerulea*" Aldrich.

Agromyza caerulea Malloch—det. Aldrich
from stem of *Eupatorium odoratum* (341-16); from morning glory seeds (141-17).

Agromyza diminuta Walker = **A. pusila** Mg.
Coquillett.

Agromyza inaequalis Malloch, J. R., Proc. Wash. Ent. Soc., Vol. XVI, No. 2, pp. 89-90, fig. 1. June, 1914: from leaves of *Vigna repens* (983-13 TYPE & 1137-16).
from leaves of lima beans (722-17 det. R. T. Cotton).

Agromyza insularis Malloch—det. Aldrich
from seed pods of Chinese mustard (699-17).

Agromyza maculosa Malloch—det. Aldrich
from leaves of aster (211-22).

Agromyza minima Mallock, J. R., "Revision of Species of *Agromyza*", Ann. Ent. Soc. Amer., Vol. VI, No. 3, p. 328. TYPE from Porto Rico.

Agromyza parvicornis Loew—det. Walton
from leaves of corn (719-12).

Agromyza neptis Loew
Coquillett.

Agromyza jucunda V. d. Wulp—det. Malloch
Coquillett.
from leaves of *Eupatorium odoratum* (1204-13, 1139-16).

Agromyza plumiseta Malloch, J. R., Ann. Ent. Soc. Amer., Vol. VI, No. 3, p. 324. TYPE from Porto Rico.

Agromyza setosa Loew
Coquillett.

Agromyza viridula Coquillett, D. W., "New Acalyptrate Diptera from North America," Jour. N. Y. Ent. Soc., Vol. X, pp. 190, Dec. 1902. TYPE from Porto Rico.

Desmometopa halteralis Coquillett 00–267, TYPE from Porto Rico.

Milichia indecora Loew
Coquillett.

Ophthalmomyia cineria Coquillett 00–268, TYPE from Porto Rico.

Ophthalmomyia lacteipennis Loew
Coquillett.

Leucopis bella Loew
Coquillett; from larvae feeding on *Dactylopius (Pseudococcus) citri.*
from *Pulvinaria psidii* Mask., on jobo (*Spondias lutea*) tree at Arroyo (173–12).

Cerodonta dorsalis Loew
Coquillett.
from mine in corn leaf (513–17).

HIPPOBOSCIDÆ.

Ornithoctona erythrocephala Leach
(as *Ornithomyia cryptocephala* Leach) Stahl.
Roeder. Gundlach, "Se encuentra en aves de diferentes familias."
Coquillett: on sparrow hawk
collected by Mr. Alex Wetmore on sparrow hawk at Aibonito and Cabo Rojo; on P. R, Dove at Caguas, Jan. 8, 1911.

Lynchia maura Bigot—det. Aldrich
from domestic pigeon (8–21).

Olfersia albipennis Say
collected by Mr. Alex Wetmore at Río Piedras, Dec. 22, 1916.

Melophagus ovinus Linne
Van Z. (P. R. 91) on sheep.

STREBLIDÆ.

Trichobius dugesii Townsend
(as *Strebla vespertilionis* (as Fallen) Fabr.) Gundlach, "Vive sobre los murciélagos."
Coquillett.

Aspidoptera buskii Coquillett, D. W., "New Genera and Species of Nycteribidae and Hippoboscidae", Can. Ent., Vol. XXXI, pp. 333–336, Nov. 1899. TYPE from Bayamón, P. R., on bats (*Artibeus* sp.)

Pterellipsis araeneae Coquillett, D. W., 90–334, TYPE from Porto Rico: on bats.

SIPHONAPTERA.

Ctenocephalus canis Curtis
Van Z. (1708) on dog.

Ctenocephalus felis Bouché
Van Z. (1718) on rat.

Dermatophilus penetrans Linnaeus
(as *Pulex*) Stahl — "nigua".
(as *Sarcopsyllus*) Van Z. (1715) on man.
Common on man, usually after bathing on sandy beaches (Condado and Pt. Cangrejos), ocassionally abundant on clay soil under houses. Supposed to cause large scabs on hogs.

Echidnophaga gallinacea Westwood
(as *Sarcopsylla*) Van Z. (1719) on rat and fowls.

Pulex irritans Linnaeus
Stahl — "pulga".
on man at Pt. Cangrejos—det. F. C. Bishopp.

Xenopsylla cheopis Rothschild
Van Z. (1714) on rat.

THYSANOPTERA.

THRIPIDÆ. THRIPS.

Determinations of thrips have been made by Mr. H. M. Russell, Mr. J. D. Hood and Mr. A. C. Morgan.

LITERATURE.

Hood, J. D., "On a Collection of Thysanoptera from Porto Rico." *In* Insecutor Inscitiae Menstrus, Vol. 1, No. 12, pp. 149–154, December, 1913.

Dinurothrips hookeri Hood 13–149, TYPE from Porto Rico.
Van Z.

Frankliniella insularis Franklin (=*Euthrips*)
Hood 13–149. Van Z. Wetmore 16–72: eaten by Green Mango, *Anthracothorax viridis.*
on flowers of roble, *Tecoma pentaphylla* (265–12 det. Russell).

Frankliniella williamsi Hood—det. A. C. Morgan
(as *Frankliniella* sp.) Smyth 19–138: the yellow cane thrips.
(as "yellow thrips of cane") Wolcott 21–13: abundant inside the central whorl of leaves during extended droughts.
on sugar cane at Guánica (140–21, 8–22), at Barceloneta (7–22).

Gynaikothrips uzeli Zimmermann
Hood 13–149. Van Z.

Haplothrips gowdeyi Franklin
Hood 13–149. Van Z.

Haplothrips tibialis Hood, J. D., "Two Porto Rican Thysanoptera from Sugar Cane" *In* Insecutor Inscitiae Menstruus Vol. 2, No. 3, pp. 38–41, March, 1914: TYPE from Porto Rico.
Jones 14–463: on sugar cane, reference to description by Hood.
Smyth 19–138: the black cane thrips.
(as "black thrips") Wolcott 21–13: note.
on sugar cane (8–14 det. Hood, 17–14), at Guánica (141–21), not abundant.

Haplothrips femoralis Reuter
Hood 14–38. Van Z.
Jones 14–463: one specimen on sugar cane.
on sugar cane (8–14 det. Hood).

Heliothrips haemorrhoidalis Bouche
Hood 13–149. Van Z.
on orange leaves at La Muda (68–20 det. Smyth).

Heliothrips rubrocinctus Giard—det. Russell
(as *Selenothrips*) Hood 13–149. Van Z.
on leaves of jobo, *Spondias lutea* (687–12 det. Russell, 721–16), of *Acalypha wilkesiana* (34–20), very injurious to young leaves of mango.

Heterothrips sericatus Hood, J. D., "Two New Thysanoptera from Porto Rico," *In* Insecutor Inscitiae Menstruus, Vol. 1, No. 6, pp. 65–70, pl. 1, June, 1913: TYPE from Porto Rico.
Van Z.
in blossoms of *Psidium guajava* (507–12 det. Russell).

Mesothrips ficorum Marchal = **Liothrips bakeri** Crawford
Russell, H. M., "The Red-Banded Thrips" Bull. 99, pt. II, pp. 17–29, 1912. Bureau of Entomology, U. S. Dept. Agr., Washington, D. C.: on *Ficus* in Porto Rico, footnote, p. 17.
Hood 13–65: Van Z.
on leaves of *Ficus nitida* (18–12 det. Russell), common on this host in the plazas at San Juan, Río Piedras and Guayama.

Podothrips semiflavus Hood 13–65, TYPE from Porto Rico.
Van Z. Smyth 19–138: on sugar cane and Para (malojillo) grass.
on malojillo grass, *Panicum barbinode* (227–12 det. Russell) at Guánica.

Thrips tabaci Lindemann—det. Russell.
Jones 15–2: on onion.
Cotton 18–303: very destructive to onions. Notes.
on onions (508–12 det. Russell), at Mayagüez and Sabana Grande (Agr. Agents); on *Solanum torvum* (63–17 det. Smyth).

Ommatothrips sp. nov.
Wetmore 16–111: eaten by Reinita, *Coereba portoricensis*.

HEMIPTERA.

Mr. Otto Heidemann made the earlier determinations of Hemiptera on which the original records in this section are based, and Mr. E. H. Gibson those at a later period, besides describing two species of *Dicyphus* which feed on tobacco. More recently Mr. W. L. McAtee of the Bureau of Biologic Survey has made many determinations, and to him the writer is also indebted for references to literature.

Of the families, Dr. W. D. Funkhouser has determined the Membracidae, Mr. F. Muir of the Experiment Station of the Hawaiian S. P. A., the Fulgoridae, and in the Jassidae (Cicadellidae) Dr. E. D. Ball and Prof. Z. P. Metcalf made some of the determinations, while more recently Prof. D. L. DeLong has redetermined and described a considerable number of species. Dr. A. L. Quaintance, with Dr. A. C. Baker, have determined the Aleyrodidae, and although they have published descriptions of a number of new species from Porto Rico, the descriptions of several others are still in manuscript. The earliest authoritative determinations of the Aphiidae were by Mr. J. J. Davis, later determinations have been made by Mr. H. F. Wilson, Dr. Edith M. Patch and Dr. A. C. Baker. Mr. E. R. Sasscer and Mr. E. W Rust determined all the earlier collections of Coccidae, but Mr. Harold Morrison and Prof. G. F. Ferris have made the more recent determinations and both have described one (the same) new species from Porto Rico.

LITERATURE.

Barber, H. G., "A Preliminary Report on the Hemiptera-Heteroptera of Porto Rico Collected by the American Museum of Natural History" American Museum Novitates, No. 75, May 11, 1923, pp. 1–13. (The new species described and the others which are listed in Mr. Barber's paper are not noted below as it was received after the manuscript had been sent to the printer.)

CORIXIDÆ.

Corixa reticulata Guerin

Gundlach.

(as sp.) Wetmore 16–29, 40, 41, 43, 45, 61, 63, 128: eaten by Lesser Scaup Duck, Killdeer, Sandpipers, Wilson's Snipe, Ani,

Woodpecker and Grasshopper Sparrow, and of the Lesser Yellow-Legs at Cabo Rojo it constituted 57.5% of the stomach contents, and of the Black-Necked Stilt over 50%.

NOTONECTIDÆ.

Notonecta sp.
Wetmore 16–41, 44, 61: eaten by Sandpipers and Ani.

Plea sp.
Wetmore 16–41, 100: eaten by Sandpiper and Water Thrush.

Plea striola Fieber
Wetmore 16–35, 75: eaten by Gallinule and Black Swift.

BELOSTOMIDÆ.

Belostoma medium Guerin
Stahl. Gundlach.
at light (34–12, 122–12, 1043–16), at Yauco (408–14).

Zaitha anura Herrich Schaeffer
Gundlach, "en las lagunas."
at light (87–15, 1043–16 — abundant Oct. 25), at Condado (90–16), at Humacao (61–13), at Guánica in abundance (585–October 2, 1913), at Mayagüez (520–12), unlabeled specimens det. McAtee.

SALIDÆ.

Micranthia humilis Say—det. McAtee
on weeds at Ciales (649–21).

REDUVIIDÆ.

Zelus longipes Linnaeus
AMNH at San Juan.
(114–13), at Trujillo Alto (726–12), feeding on larvae of *Haltica jamaicensis* Fabr. (152–13); at Yabucoa with *Tachytes argentipes* Smith on its beak (158–16); in mountains north of Yauco feeding on *Alysia analis* Cresson (43–23); at Aibonito (SSC).

Zelus rubidus Lap. & Serv.
(as *Evagoras tricolor* L. & S.) Stahl.
Gundlach.
Wetmore 16–77: eaten by Grey Kingbird, *Tyranus domingensis.*
Van Z. (5033) predaceous on cutworms and flies.
Jones 14–462: attacking the larvae of *Laphygma frugiperda* S. & A.
(642–12, 144–17), eating *Diabrotica graminea* Baly and a small fly (180–11), eating a small fly (193–11), eating *Lucidiota decorus* G. & H. (678–12); often common on spikes of *Achryanthus indica* waiting for flies to alight (GNW); on corn at Caguas (129–11 det. Heidemann); at Arroyo (12A–19); at Hatillo (123–18); at Yauco (772–15).

Zelus subimpressus Stal
(as *Diplodus*) Gundlach.

Zelus nugax Stal—det. McAtee
(as sp.) Wetmore 16–61, 77, 80: eaten by Ani, Kingbird and Petchary.
(58–11, 854–14), on sugar cane (325–12, 604–12), at Arecibo (635–21), at Toa Alta (454–21), at Rincón (GNW); on grass and weeds (236–16), at Pt. Cangrejos (GNW); on grapefruit foliage at Vega Baja (512–16), all stages at Vega Alta (102–17, 219–17); on *Inga laurina* at Lares (261–22).

Rocconota sp.
Wetmore 16–80: eaten by Petchary, *Tolmarchus taylori*.

Stenopoda cinerea Laporte
Stahl.

Stenopoda culiciformis Fabricius
Gundlach.
(284–12).

EMESIDÆ.

Ploiariodes rubromaculata Blackburn—det. McAtee
feeding on thrips on foliage of *Spondias lutea* (728–16), on mosquitoes on walls of house (622–16).

Ploiariodes armata Champion—det. McAtee
on foliage of grapefruit at Vega Alta (222–17).

Emesa affinis longipes DeGeer
Gundlach, determined by Dr. Uhler.
(as sp.) Wetmore 16–119: eaten by Mozambique.

Westermannia tenenima Dohrn, A., *in* Linnaea Entomologica, Vol. 15, pp. 48–49, 1863, TYPE from Porto Rico.

Ghilianella varicornis Dohrn ,A., *in* Linnaea Entomologica, Vol. 14, pp. 226–227, 1860, TYPE from Porto Rico.

ANTHOCORIDÆ.

Asthemidea picta Uhler (?)—det. H. G. Barber
in buds of *Partium tiliaceum* at Arecibo (249–22).

Lasiochilus divisus Champion
Wolcott 21–14: "The Pink Leafsheath Bug. All stages - - - under the older green leaf-sheaths of high cane." Illustration of adult.
under leaf-sheaths of sugar cane (194–11, 201–11 det. Heidemann), possibly predaceous on mites, *Tarsonemus spinipes* Hirst (721–13), at Barceloneta (GNW — det. Gibson).

Triphleps insidiosus Say

(312–12), on squash leaves (518–17), on corn, presumably predaceous on *Aphis maidis* Fitch (536–12 det. Heidemann), *on red spider on beans (427–16)*; under leaf-sheaths of sugar *cane at Arecibo (1068–16* det. McAtee); at Isabela on red spider on cotton (214–21).

CIMICIDÆ.

Cimex lectularius Linnaeus

(as *Acanthia*) Stahl, "chinche de cama."

Van Z. (1704).

GERRIDÆ.

Tenagogonus (Limnometra) quadrilineatus Champion—det. Heidemann.

Van Z.

Limnogonus marginatus Guerin

(as *Gerris*) Stahl. Wetmore 16–22: eaten by Cuban Green Heron.

(as *Limnotrechus*) Gundlach.

AMNH at Coamo.

on water in ditch (712-16); at light at Guánica (614–13).

VELIDÆ.

Mesovelia sp.

Wetmore 16–41: eaten by Spotted Sandpiper.

Microvelia albonotata Champion—det. McAtee

(as sp.) Wetmore 16–40, 41: eaten by Killdeer and Spotted Sandpiper.

on surface of water (250 16); at light (203–11), at Guánica (EGS).

Microvelia pulchella Westwood

Gundlach.

Rhagovelia angustipes Uhler

AMNH at Naguabo and Maricao.

MIRIDÆ (CAPSIDÆ).

Bolbosia deflexa Uhler MS—det. Gibson

from weeds in cane field (385–12).

Dicyphus luridus Gibson, E. H., "Two New Species of **Dicyphus** from Porto Rico" *in* Canadian Entomologist, Vol. 49, No. 6, pp. 218–19, June 1917, TYPE from Porto Rico.

Cotton 17–113 to 118, pl. 1 with 8 figs.: "The Large Tobacco Suck-Fly", illustrations and descriptions of all stages, life history and control.

on tobacco (346–17), at Ciales (782–13), at Juncos (153–

16), at Aibonito (323–17 TYPT), at Cayey (127–16); on tomato (201–16); on *Jathropha gossypifolia* at Martin Peña (842–14); on *Amaranthus spinosus* at Cayey (127–16).

Dicyphus prasinus Gibson 17–218, TYPE from Porto Rico.
Cotton 17–119, fig. 1: notes. "Smaller and more slender (than *D. luridus* with) 'a large, irregular fuscous spot near the costal margin of each wing-cover and midway between base and apex', not so abundant on tobacco, – – – more frequently on tomato."
on tobacco at Aibonito (324–17 TYPE), at Cayey (320–17); eggs in the midrib of tobacco leaves (345–17).

Nabidea (Collaria) explicata Uhler—det. McAtee
nymps and adults on rice at Canóvanas (196–16); on weeds (426–17).

Crenotiades rubinervis Stal
AMNH at San Juan and Arecibo.

Trigonotylus sp.—det. McAtee
abundant on Bermuda grass (262–21).

Lygus apicalis Fieber—det. AcAtee
on carrots (526–17), on weeds (428–17); on tender growth of *Inga laurina* at Lares (167–22).

Lygus sallei Stal
Gundlach.

Poeciloscytus cuneatus Uhler—det. McAtee
(311–12), on beans and tomatoes (200–16), on *Amaranthus, Verbesina alba* and other weeds (427–17, 502–16), on carrots (527–17); on tobacco at Cayey (37–16, 126–16); on sugar cane at Guánica (GNW).

Pycnoderes incurvus Distant—det. Gibson
Cotton 18–306: "The Small Black Squash Bug", illustration and notes. "All stages on squash and melon vines - - - small translucent, flask-shaped eggs are inserted in the tissue of the stems and large veins of the leaves, and hatch in a few days into small, wingless, greenish-white nymphs. - - - feed on the underside of leaves - - - moulting five times - - - retain greenish-white color until they become adults."
on squash and cucumber (643–17).

Pycnoderes quadrimaculatus Uhler
Gundlach, "no es rara en el *Solanum torvum.*"

"Apparently a new species of 'Fuscus Distant'"—det. Mc.Atee.
on foliage of grapefruit at Vega Alta (220–17).

PHYMATIDÆ.

Phymata angulata
Wetmore 16–61: eaten by Ani.

Phymata erosa Linnaeus
Gundlach.

Phymata marginata Fabricius
Gundlach.
(as sp.) Wetmore 16–66, 98, 102, 114: eaten by Tody, Jamaican Vireo, Prairie Warbler and Yellow-Shouldered Blackbird.
at Comerío (758–13 det. McAtee).

Macrocephalus bergrothi Handl.—det. McAtee
on *Inga laurina* at Lares (155–22).

Macrocephalus granulatus Champion—det. McAtee
(as sp.) Wetmore 16–66: eaten by Tody, *Todus mexicanus.*
on coffee at Lares (287–21).

TINGITIDÆ.

Leptopharsa illudens Drake = **Atheas pallidus** Barber 23–6, TYPE from Porto Rico.
(as *Atheas nigricornis* Champion—a misidentification according to Dr. Drake) Barrett 05–396: on cassava, *Manihot* sp.
on "yuca", *Manihot* sp. (309–23 det. Drake).

Corythuca gossypii Fabricius—det. Heidemann
Van Z. (1254) on *Carica papaya*, *Anona muricata* and *Canavalia ensiformis.*
Jones 15–4: "breeds on the underside of yautía leaves, also - - - of sword bean (*Canavalia ensiformis*) and castor bean (*Ricinus communis*)."
Cotton 18–313: on yautía.
Smyth 20–124: "on an occasional cotton leaf - - - more injurious to castor-bean and lima bean."
on sword bean (204–12), at Pt. Cangrejos (GNW det. McAtee); on castor bean at Ciales (783–13), at Luquillo (96–16); on yautía at Mameyes (810–12); on lima beans at Guayama (664–17); scarce on cotton at Camuy (222–21).

Corythaica carinata Uhler—det. Carl J. Drake.
at San Juan, July 9–12, 1914. (record by Dr. Drake).

Corythaica monacha Stal—det. Heidemann
Van Zwaluwenburg 16–43: "very common on the under-leaf surface and on the topmost leaves of eggplant."
Jones 15–4: "all the foliage of eggplant withered - - - *Solanum torvum* also often attacked."
Cotton 18–297: "small, flask-shaped eggs in the tissue of the leaves - - - small wingless nymphs - - - attain adult form in

about ten days after hatching. Controlled with soap and water spray."

Cotton, R. T., "The Eggplant Lace-Bug in Porto Rico" *in* Jour. Dept. Agr. P. R., Vol. 1, No. 3, July 1917, pp. 170–173: life history, descriptions of stages, natural enemies and control.

on eggplant (533–12, 147–20), on *Solanum torvum* (359–12, 529–16), at Cayey (250–21), at Fajardo (469–12); on tobacco at Juncos (152–16).

Monanthia monotropidia Stal—det. McAtee

nymphs and adults abundant on underside of leaves of small unidentified tree in mountains north of Yauco (266–22).

Teleonemia sacchari Fabricius

AMNH at San Juan.

(750–14), on *Verbesina* flower (509–16).

Leptodictya bambusae Drake, Carl, *in* Ohio Jour. Science, Vol. 18, No. 5, March 1918, p. 175, TYPE from Mayagüez, Porto Rico: on bamboo.

LYGÆIDÆ.

Blissus leucopterus Say

AMNH at San Juan.

(695–17), on discarded cane stalks (714–12 det. Gibson); on injured cane shoots at Manatí and Vega Baja (nymphs — GNW); on sugar cane on Vieques Island (GNW); abundant and causing injury to roots of guinea grass at Hatillo (334–22); constituting 10% of the food of the lizzard, *Anolis pulchellus,* at Río Piedras (GNW).

Ischnorhinchus championi Distant

AMNH at Maricao.

Ninus notabilis Distant—det. McAtee

swept from grass (453–16).

Oedancala cubana Stal

Gundlach.

Lygaeus bicrucis Say—det. McAtee

at light (615–12, 299–16), at Guánica (643–13, most abundant Oct. 8), at La Plata (GBM); (has black prothorax margined with light yellow — probably another species) abundant and mating on *Conchorus hirsutus* at Pt. Cangrejos (70–16).

Lygaeus collaris Fabricius

Stahl.

Lygaeus fasciatus Dallas

Stahl. Gundlach.

Nysius providus Uhler
Uhler, "Hemiptera-Homoptera of Grenada, W. I." p. 182, 1894. (Van Z.)

Nysius spurcus Stal—det. Gibson
swept from weeds (349-17, 420-17); all stages common on *Hyptis pectinata* (749-14).

Oncopeltus aulicus Fabricius
Van Z. (det. Heidemann).
AMNH at Arecibo.
on milkweed, *Asclepias curassavica,* at Pt. Cangrejos (288-22), at Comerío (759-13), at Vega Baja (517-16), at Vega Alta (50-17, 172-15).

Ozophora pallescens Distant—det. McAtee
at light (251-16).

Clerada apicicornis Signoret
Gundlach, "se encuentra en toda la isla."

Orthaea bilobata Say
(as *Pamera*) Van Z. (P. R. 717).
AMNH at Coamo.
swept from weeds (409-17), at Pt. Cangrejos (GNW); all stages on *Piriqueta cistoides* (870-14), feeding on seed capsules of *Portulaca oleracea* (523-16); on cotton at Isabela (158-21).

Orthaea vincta Say
(as *Pamera*) Gundlach.

Paromius longulus Dallas
(as *Pamera*) Gundlach.
AMNH at Naguabo.
(855-14), on grapefruit tree at Vega Alta (171-15).

Geocoris sp.
Wetmore 16-66: eaten by Tody.

PYRRHOCORIDÆ.

Dysdercus andreae Linnaeus The Common Cotton-Stainer or "Unión".
Van Z. (P. R. 716). AMNH at Coamo, Guayanilla, Tallaboa.
Smyth 20-123: "more frequently found in the drier - - - sections, sometimes locally abundant, - - - not a serious pest of cotton."
(as *D. suturellus* Herr. Sch.) Barrett 05-396: "caused considerable damage in a cotton field near Sabana Grande."
May 06-11: mention.
at light at Guánica (406-14); on cotton at Isabela (208-21), at Boquerón (21-23), at Guánica (251-17), at Guayanilla (GNW — det. B. Uvarov, through Dr. Marshall).

Dysdercus neglectus Uhler—det. McAtee (**D. sanguinarius** Stal—det. H. G. Barber)
on cotton at Quebradillas (186–22), at Vega Baja (295–22), at Algarrobo (194–22).

Largus rufipennis Castelnau
Van Z. (P. R. 115).

Largus varians Stal—det. McAtee
on coffee at Ciales (59–21, 258–22), at Lares (417–22); on Bromelid on *Erythrina glauca* at Cayey (352–22).

COREIDÆ.

Corizus hyalinus Fabricius—det. McAtee
on weeds and tomato (237–16).

Corizus sidae Fabricius
Gundlach. Van Z. (933) on okra.
(as sp.) Wetmore 16–61: eaten by Ani.
swept from weeds (410–17), at Humacao (672–17 det. McAtee); common on *Amaranthus* flower heads (545–16); all stages abundant on *Waltheria americana* at Boquerón (17–23).

Eggs are cream colored, barrel-shaped and finely pitted, the pits in the circle around the lid being larger.

Just-hatched nymphs are oval, black or dark reddish-purple, with a large white oval latero-dorsal spot on each side of the first segment of the abdomen anteriorly, and four smaller and more median ones posteriorly.

Second instar nymphs have antennae, legs, head and thorax transparent pink, abdomen is black, the large white spots persistent, the others appear as lighter margins laterally of dark red median areas.

Larger nymphs have yellow antennae, pear-shaped yellow head with light reddish-brown eyes and a large dark-colored beak extending nearly to posterior end of the body. Thorax is narrower than the head, reddish-brown with extensive markings of greenish white, the legs are light yellow, incompletely or irregularly banded with dark red. Abdomen is round, flattened beneath, about twice as wide at the thorax, reddish-brown, irregularly banded with greenish-white and broken with large black warts. In the fully-grown nymphs, the antennae are darker, especially the terminal knobbed segment, head is lemon yellow with extensive darker areas, wing pads are yellow; the thorax and abdomen are red only at sutures, the greenish-white bands are more extensive, the black warts are conspicuous, the pointed tip of the scutellum in greenish-white and elevated.

Serinetha coturnix Burmeister
(as *Jadera sanguinolenta* Fabr.) Gundlach, with *Serinetha coturnix* Burm. in synonymy. "Creo que *coturnix* es un sinónimo y no otra especie."
(as *Pyrrhotes sanguinolenta* Fabr.) Van Z. (P. R. 118).
at light (405–12 det. McAtee), at Pt. Cangrejos (GNW), at Humacao (54–13), at Guánica in abundance (580–13, 1304–13).

Leptocorisa filiformis Fabr.
Gundlach, "posible *L. tipuloides* DeGeer - - - sinónimo."

Alydus (Megalotomus) pallescens Stal
Gundlach. (as *A. rufipes* Westw.) AMNH at Arecibo.
swept from cowpeas (96–12), from weeds at Laguna San José (838–14 det. McAtee), at Algarrobo (769–14).

Hyalmenus serratus Fabricius
AMNH at Arecibo.

Protenor tropicalis Distant—det. McAtee
(one unlabeled specimen.)

Schictyrtus whitei Guerin
AMNH from Mona Island.
Van Z (P. R. 701) from Mona Island.
common on Mona Island (1303–13).

Zicca taeniola Dallas
Gundlach. Van Z. (P. R. 116).
swept from weeds (417–17, 238–16); on curcurbits at Añasco (1033–13), abundant on seed-heads of *Amaranthus* at Guánica (566–16).

Catorhintha guttula Fabricius
AMNH at Aibonito and Coamo.
Wetmore 16–61: eaten by Ani.
swept from weeds at Humacao (671–17); abundant on sticky-capsule vine, *Commicarpus scandens,* at Aguirre (70–16); on sugar cane (presence probably accidental) at Yauco (239–21), at Añasco (GNW).

Leptoglossus balteatus Linnaeus
Gundlach. (as *Anisoscelis thoracicus* Guer.) Stahl.

Leptoglossus gonagra Fabricius
Gundlach. AMNH at San Juan.
(as *Anisoscelis*) Stahl.
Cotton 18–307, fig. 61: "This large brownish-black bug (was) found with its long needle-like proboscis inserted in the stems of the squash vine. It lays small, brown, barrel-shaped eggs

in a single row on the stems of the vine, (which) hatch into small bright-red and black nymphs - - - (which) pass through a number of forms and color changes before becoming adults."

on weeds in cane field (646–12, 748–12); on corn at Sabana Llana (127–15); on *Cleome spinosa* at Cayey (177–16).

Leptoglossus stigma Herbst

Gundlach. (as *Anisoscelis serrulatus* Herr. Sch.) Stahl.

Leptoglossus zonatus Dallas—det. Gibson

resting on *Psidium guajava* at Ciales (784–13)

Phthia picta Drury

Gundlach. Van Z. (det. Heidemann). AMNH at San Juan.

Jones 15–4, pl. 1, fig. 3: "Both adults and nymphs attack the fruit of tomato and *Solanum nigrum* var. *americanum.*"

Cotton 18–311: "The bright-red wingless nymphs congregate in groups on developing (tomato) fruit and distort it with their punctures."

on tomato (748–14, 185–16, 447–16, 542–16), on *Solanum nigrum* var. *americanum* (716–14, 328–16, 521–16, 542–16, 563–16, 84–20), on weeds (239–12, 386–12, 489–12, 418–17), on *Physalis* (521–16); on curcurbits at Añasco (1032–13).

Phthia lunata Fabricius

Gundlach. (as *Leptoscelis*) Stahl.

Chariesterus moestus Burmeister

Van Z. (det. Heidemann). (as *Corestus*) Stahl.

from weeds (387–12, 581–12), at Humacao (670–17 det. McAtee); from curcurbits at Añasco (1034–13); from *Amaranthus* at Yauco (385–21) at Toa Alta (GNW).

Chariesterus gracilicornis Stal

Gundlach.

Sephina indierae sp. nov.

Antennae, eyes, base of beak, legs, anterior and lateral margins and large postmedian spot on disc of prothorax, scutellum, median and apical areas of basal half of forewing and all membrane, the posterior angles of the abdominal segments, black. Head, ocelli, narrow semicircle on disc of prothorax, base and anteapical areas of basal half of forewings, crimson; portions of the thorax and abdomen darker red varying to black with large, margined, lighter-colored spiracular openings. Except for membrane of the wing, entirely covered with abundant short black hairs, especially abundant and long on prothorax above, giving a coarse velvety appearance. Antennae inserted on callosities in front of the small eyes, nearly as long as the body, 1st and 2nd, and 3rd and 4th segments approximately equal in length, all subequal. Prothorax much

broader behind than in front, sharply depressed anteriorly to a deep and broad submarginal transverse furrow, with a short medio-dorsal longitudinal furrow extending upward to the more or less flattened area between the lateral angles. Length 20 mm. width at angles of thorax, 6.5 to 8.5 mm.

described from eight adults, all in coitu, on parasitic vine, *Metastelma* sp., in deserted coffee grove, region locally known as "La Yndiera", in mountains north of Yauco (147–June 16, 1921), Seín & Wolcott collectors, generic determination by Mr. McAtee.

Spartocera batatas Fabricius

Van Z. (922) on sweet potato leaves. AMNH at San Juan.

Jones 15–4, pl. 1, fig. 2: "Adults and nymphs -- in great abundance on sweet potato, their beaks imbedded in the stalks and leaf petioles."

(as *S. fusca* Thunbg.) Gundlach. Busck 00–90; Cotton 18–310: notes.

Wetmore 16–61, 98: eaten by Ani and Jamaican Vireo.

on sweet potato (109–18), at Carolina (11–19), at Naguabo (47–14 det. Heidemann), at Hatillo (121–18); all stages abundant on eggplant (446–16, 508–16), on *Solanum nigrum* var. *americanum* (541–16), at Fajardo (464–12), at Guayama (71–21); adults on sugar cane (accidental) at Barceloneta (63–11); clusters of golden eggs abundant on bark of *Erythrina glauca* trees at Cayey (326–17), on posts (47–15, 137–16); control by dusting with Calcium Cyanide (F. Seín).

PENTATOMIDÆ.

(**Pentatoma tincta** Dahlb.
Stahl.)

Arvelius albopunctatus DeGeer

Gundlach. Van Z. (935) on tomato and *Solanum torvum*. AMNH at Mayagüez.

Cotton 18–312: "on tomato."

(as *Pentatoma*) Stahl.

on tomato (187–16), at Hatillo (119–18); on fruit of *Solanum torvum* at Mameyes (380–22), at Barranquitas (402–22).

Edessa bifida Say

Gundlach. AMNH at Arecibo.

(as *Aceratodes cornuta* Burm.) Stahl.

(as *E. cornuta* Burm.) Van Z. (P. R. 119).

(as sp.) Wetmore 16–61: eaten by Ani.

on sugar cane (accidental) (90–19), on weeds (136–12, 631–12, 738–12, 412–17), on morning-glory, *Ipomoea rubra,* nymphs and adults feeding on terminal shoots and tender stems (287-16, 291–16, 322–16, 611–16, 685–16, 63–20, 85–20); at Naguabo (728–14 det. as *E. cornuta* Burm. by Mr. Gibson); at Hatillo (120–18); on *Cassia* sp. at Sabana Llana (446–19).

Edessa sp. (not **affinis** Dallas—compared with type in British Museum).
(as *Edessa affinis* Dallas — det. McAtee) Wolcott 23–46: on coffee. Wolcott 22a–5: illustration of adult.
(as *E. vinula* Stal) AMNH at Aibonito.
on coffee at Jajome Alto (369–21), at Aibonito (236–21), at Ciales (466–21, 80–22), at Corozal (457–21), at Utuado (478–21), at Lares (144–20, 322–21, 390–21, 110–22), at Maricao (81–22), in the mountains north of Yauco (145–21, 114–22, 235–22); nymphs and adults on *Solanum torvum* in the mountains north of Yauco (262–22).

Euschistus bifibulus Palisot de Beauvois—det. Heidemann
Van Z. (P. R. 709).
Cotton 18–280 and 312: on beans and on tomato.
on weeds (61–12, 388–12, 416–17), on *Gynandropsis pentaphylla* (501-12), on tomato (184–16), on beans (199–16, 342–17), on *Solanum nigrum* (296–16, 482–16, 520–16, 600–16), on *Physalis angulata* (520–16, 600–16), on asparagus fern (87–19); on grapefruit foliage at Vega Alta (101–17); on cucurbits at Guánica (1030–13).

Euschistus crenator Fabricius
AMNH at Coamo.
(834–14)

Loxa flavicollis Drury
Gundlach. Van Z. (P. R. 720).
at light (238–12), at Carolina (1045–16).

Loxa sp.—det. McAtee
on cotton at Pt. Cangrejos (551–22).

Mormidea ypsilon Linnaeus—det. McAtee
on grass in pasture at Guaynabo (724–17).

Nezara (Acrosternum) marginata Palisot de Beauvois
(Orifice of osteolar canal "long and curved, becoming gradually evanescent, extends almost to the posterior lateral angle of the metapleura." Jones.)
Gundlach. Van Z. (P. R. 113). AMNH at Tallaboa.
(as *N. viridula* Linn.) Cotton 18–312: "on tomato".
on tomato (186–16, 348–17); on tobacco at Juncos (154–16); at light at Guánica (1071–13).

Nezara viridula Linnaeus
(Orifice of osteolar canal with raised margin, most prominent towards the apex, where it is sharply truncated, "and does not extend more than half way to the lateral margin of the metapleura." Jones.)
(as *Pentatoma smaragdula* Fabr.) Stahl.

(as sp.) Wetmore 16–61, 77, 80, 82, 98: eaten by Ani, Kingbird, Petchary, Flycatcher and Jamaican Vireo.
Van Z. (P. R. 704). AMNH at Tallaboa.
on cowpeas (91–12), on beans (785–14), on *Cleome spinosa* (500–12); at Añasco (1031–13); on sugar cane (accidental) at Humacao (53–13); on coffee at Lares (311–21); on tobacco at San Lorenzo and reported as causing damage (11–21); on Vieques Island (GNW); on Mona Island (1319–13).

Piezodorus guildingi Westwood
Cotton 18–280: on beans. AMNH at Arecibo.
on cowpeas (72–12, 177–12 det. Gibson), on beans (786–14, 159–16, 198–16, 564–16), on *Chamaecrista deschynomene* (619–16, 707–16); at light at Guánica (1072–13); on Vieques Island (GNW).

Piezosternum subulatum Thunberg—det. Gibson
Nymphs are bright yellow, becoming orange on abdomen; wing-pads, scutellum, prothorax laterally and outer portions of abdominal segments posteriorly broadly margined with black, also antennae and eyes are black, besides bands extending to the sides of the scutellum, joined in the middle of the prothorax with the marginal bands, and a median band on head, narrowly divided on prothorax, more widely on scutellum, and as a series of crescents on the abdomen.
Adults yellow and dark green, scutellum with a median ridge, greatly extended and sharply pointed posteriorly.
all stages on *Passiflora* sp. (937–13); on coffee at Lares (292–21), at Ciales (217–22).

Proxys victor Fabricius
Van Z. (P. R. 117). (as sp.) Wetmore 16–61: eaten by Ani.
on curcurbits at Añasco (1029–13); on grapefruit at Vega Baja (491–16); on squash vine in grapefruit grove at Vega Alta (224–17); on weed at Guayama (70–21).

Proxys punctulatus Palisot de Beauvois
Gundlach.
(as *Pentatoma (Prionony x) punctata* Pal. de B.) Stahl.

Solubea pugnax Fabricius
(as *Pentatoma (Mormidea) typhaeus* Fabr.) Stahl.
(as *Oebalus*) Gundlach.

Thyanta antiguensis Westwood
Van Z. (P. R. 718).
(as sp.) Wetmore 16–61, 75, 82, 89, 91, 93, 96: eaten by Ani, Black Swift, Flycatcher, Martin, Mockingbird, Thrush and Latimer's Vireo.
on beans (568–16); on weeds (411–17), at Guánica (503½–13, 1107–13); abundant on rice at Canóvanas (190–16).

Thyanta perditor Fabricius
(as *Mormidea*) Stahl.
Gundlach. Van Z. (P. R. 705). AMNH at Mayagüez.
Wetmore 16–58, 61, 89: eaten by Mangrove Cuckoo, Ani and Martin.
on weeds (341–17), at Carolina (RTC), at Añasco (1109–13), at Vega Baja (510–16); on *Cleome spinosa* at Cayey (188–16); all stages abundant on *Piriqueta cistoides* Mey. (831–14 det. Gibson).

Podisus sagitta Fabricius
Gundlach.
(832–14), at Aibonito (SSC — det. McAtee); resting on cotton at Boquerón (35–23).

Podisus sculptus Champion—det. McAtee
on coffee leaves (726–17).

Mutyca grandis Dallas
Van Z. (det. Heidemann).
(one unlabeled specimen — det. McAtee.)

Mutyca phymatophora Palisot de Beauvois
Gundlach. Van Z. (P. R. 710).

Pharypia pulchella Drury
Van Z. (P. R. 112).

SCUTELLERIDÆ.

Pachycoris torridus Scop.—det. Gibson
Smyth, E. G., "Un Insecto Extraño que Cubre su Cría lo Mismo que una Gallina" Rev. Agr. P. R., Vol. 2, No. 4, March 1919, pp. 27–31, pl. 2: (an extraordinary insect which broods her young like a hen).
First instar nymphs are bright red, in following instars metalic green with orange-red dots; adults velvety blue-black with orange-red spots, the four largest on the abdomen often coalescing and in a few individuals extending over nearly the entire abdomen.
on *Croton discolor* and *Lantana involucrata* at Ponce (112–13); on *Croton humilis* at Guánica (135–15), and on this and other species of wild *Croton* at Moca (708–14), Aguadilla (229–22), Hatillo (507–18).

Pachycoris fabricii Palisot de Beauvois.
(as *Scutellera nitens* Dallas) Stahl.
Gundlach.

Sphyrocoris obliqus Germar
Gundlach.

Augocoris pallidus Herrich-Schaeffer
(as *Scutellera cretacea* Voet.) Stahl.
Gundlach.
on *Phyllanthus epiphyllanthus* at Bayamón (740–13 **det.** Gibson).

Diolcus boscii Fabr.—det. H. G. Barber
at Yauco (706–14, 837A–14).

Diolcus irroratus Fabricius—det. McAtee
flying in grapefruit grove at Pueblo Viejo (457–16); **at** Pt. Cangrejos (GNW).

(**Mesotrypa sinuosa** Uhler MS
Gundlach.)

CYDNIDÆ.

Amnestus pusillus Uhler
Gundlach, "vuela a menudo hacia las luces encendidas en **las** casas."

Rhytidiporus indentatus Uhler—det. McAtee
at light (681–17), at Manatí (597–16).

THYREOCORIDÆ.

Thyreocoris (Corimelaena) minutus Uhler
AMNH at Ponce.
on the ground among weeds at Pt. Cangrejos (GNW **det.** McAtee).

HOMOPTERA.

CICADIDÆ.

Proarna hilaris Germar
(as *Odopoea* sp.) Van Z. (P. R. 719).
Wetmore 16–57, 59, 63, 69, 77, 80, 82, 96, 98, 106, 114, 116, 119: eaten by Mangrove Cuckoo, Ground Cuckoo (4.16% of food), Woodpecker, Owl, Petchary (2.47% of food), Flycatcher, Kingbird, Vireos, Yellow Warbler, Yellow-Shouldered Blackbird, Oriole and Mozambique.
at light (436–12 det. Gibson, 692–12, 124–18), at Condado (66–11, 159–15), at Martin Peña (89–16, 262–16), at Vega Alta (160–15), at Guánica (407–14, 1136–13 det. McAtee); resting on sea-grape at Quebradillas (300–21); on grapefruit at Pt. Salinas (125–15, 179–15); nymphs in sandy soil at Mameyes (819–12), apparently feeding on roots of *Wedelia trilobata* at Pt. Salinas (GNW).

Zammara sp.—det. McAtee
(as *Proarno* sp.) Wetmore 16–77, 82: eaten by Kingbird and Flycatcher.
at light at Aibonito (1305–13); on coffee tree at Lares (481–

21), at Corozal (279–21), in mountains north of Yauco (247–22); nymphs from soil about roots of coffee trees at Añasco (375–12), of other trees (374–12).

MEMBRACIDÆ.

Antianthe expansa Germar—det. Funkhouser
Smyth 20–125: on cotton. Wolcott 23–46: on coffee.
Wolcott 23–46: on coffee.
on tomato (179–16), on *Spondias lutea* (724–16), on *Psidium guajava* (1119–16), on *Cissus sicyoides* (430–21), on mulberry (131–22); on grapefruit (178–16, 550–16, 330–17), at Vega Baja (553–16), at Vega Alta (228–17); on tobacco at Cayey (38–16); on wild Bougainvillea vine at Cayey (354–22); on *Solanum torvum* at Ciales (223–22), at Bayamón (508–17); on coffee at Corozal (283–21), at Ciales (465–21), at Utuado (477–21); on ganduli, *Cajanus cajan*, at Comerío

Monobelus fasciatus Fabricius—det. Funkhouser
Wolcott 23–46: on coffee.
on *Spondias lutea* (782–16), on *Erythrina glauca* (785–13, 964–16); on *Solanum nigrum* at Vega Baja (532–16); on *Inga laurina* at Lares (638–21, 149–22): on ganduli, *Cajanus cajan*, at Comerío (763–13, 769–13).

CERCOPIDÆ.

Epicranion championi Fowler
Van Z. (608) on coffee and *Inga laurina.*
Van Zwaluwenburg 17–516: "fairly common (on coffee); spittle masses around a berry cluster often contain as many as six nymphs."
on coffee at Lares (129–21); nymphs common on coffee throughout the coffee districts.

Philaenus fusco-varius Stal—det. McAtee
on weeds (734–17), on mulberry (131–22).

CICADELLIDÆ (JASSIDÆ).

Agallia tenella Ball (possibly **A. albidula** Uhler—det. DeLong)
Barrett 04–448; Howard 04–88: injurious to beans, cowpeas and other plants.
Jones 15–2 and 3: correctly quotes other records.
Wolcott 21–19, fig. 5: on sugar cane, in abundance at Garrochales; on *Solanum torvum* and potatoes. Illustration of adult.
on carrots (539–17, 531–17, 686–17), on string beans (206–16), on *Agati grandiflora* (155–21), on weeds (431–17), on grass (450–16, 452–16), on eggplant (448–16); on tobacco (1151–16), at Juncos (157–16); on potatoes at Jajome Alto (21–21); on tobacco at Cayey (21–21); on cotton at Camuy (227–21). All stages on tobacco (591–16).

Agallia pepino sp. nov. DeLong & Wolcott

Bluish-white. Length 2.5 mm. Eyes dark brown with creamy margins. Vertex only slightly broader behind the eyes, with lenticular median piceous spot, and a pair of round piceous spots near the anterior angle of the eyes extending on to the front and an irregular-shaped pair on the posterior margin between the others. Large yellow ocelli ringed with piceous and an inverted Y with arms extending towards bases of the antennae. Anterior margin of pronotum light chestnut, becoming broader and piceous laterally behind the eyes; a pair of large, pear-shaped dull-yellow areas with irregular piceous margins posteriorly; a lenticular piceous median spot and indistinct brownish spots near lateral angles. Scutellum with a pair of piceous spots and the broadened ends of the piceous depression partly under the pronotum. Elytra dull brown, semi-transparent, venation dull bluish-white; a bright bluish-white semicircle connecting the inner and outer sectors of the clavus with the median inner margin.

Genitalia: *Female* last ventral segment rather narrow, one-half longer than preceeding segment. Posterior margin rather broadly notched one-fourth the distance to base so as to form two rather broadly rounded lobes. *Male* valve short and broad, convexly rounding. Plates long and narrow, rather broad at base, abruptly constricted before their middle and produced into long narrow acute tips.

from carpet grass, *Axonopus compressus*, at Ciales (64–21 TYPE); on sugar cane at San Sebastián (GNW).

Agallia carrotovora sp. nov. DeLong & Wolcott

Resembling *A. sanguinolenta* Provancher. Dull yellow. Length 3 mm. Vertex of uniform length, with a pair of large oval piceous spots on posterior margin, two closely proximate median lines forming the lower arm of an inverted Y on the front, below which a double series of somewhat irregular transverse black spots extend to black-based clypeus, and in front of eyes an irregular band, with arms extending around the ocelli. Pronotum, differing from *A. sanguinolenta,* thickly dotted with piceous depressions, except at lateral angles, and solidly piceous along median line and in acute triangles on lateral margins surrounding a lenticular clear space behind the eyes. Scutellum black with a large yellow V bordering posterior margins and a pair of dull yellow spots partly under the pronotum. Elytra light brown with dark brown venation, except light yellow areas near base of corium, basal half of sectors of clavus, spots at their margins and a triangle next to the scutellum.

Genitalia: *Female* last ventral segment more than twice as long as preceeding. Lateral angles strongly produced, posterior margin concavely excavated half way to base, median third broadly bordered with brown. *Male* valve short, round-

ingly produced. Plates three times as long as last ventral segment, rather broad at base, outer margins scarcely narrowed to near apex where they are strongly convexly rounded to appressed apices.

from carrots, R. T. Cotton, collector (686–17 TYPE).

Agallia pulchra sp. nov. DeLong & Wolcott

Light yellow. Length 3 – 3.5 mm. Vertex cadmium yellow, longest near sides because of dark protruding eyes; a pair of transverse black dots on or near posterior margin making it appear angled; a pair of much larger black spots in front of eyes, a smaller median spot on anterior margin and usually another median one on front. Pronotum bright orange, fading to canary yellow on posterior margin, with black anterior margin, and median line extending between a pair of large black spots, often coalesced with margin broadened behind eyes. Scutellum yellow with black depression and a pair of black spots anteriorly. Elytra black, but with venation broadly outlined in greenish-yellow on clavus, lighter on corium, almost obliterating the black near the outer margin, and entirely so between distal portions of sections of the clavus.

Genitalia: *Female* last ventral segment longer than preceding, lateral angles produced, posterior margin concavely excavated with a narrow median incision at middle. *Male* valve short, almost concealed under last ventral segment, apex bluntly rounded. Plates rather broad at base, three times as long as last ventral segment, gradually narrowed to rather blunt tips.

from carrots (686–17); from sugar cane at Guánica (138–21); from *Inga laurina* at Lares (164–22 TYPE); from coffee at Lares (393–21), at Utuado (476–21), from mountains north of Yauco (305–21, 85–22).

Tettigonia occatoria Say

Van Z. (627) on coffee and *Inga laurina*.

Wetmore 16–66: eaten by Tody, *Todus mexicanus*.

Wolcott 21-20: on sugar cane at Morovis.

common on tender stems of coffee (47–21, 82–21 det. McAtee, as identified by Fowler in Biol. Cent. Amer., 266–21), at Adjuntas (487–21), in mountains north of Yauco (87–22), throughout the coffee growing region (289–21); on orange at Jajome Alto (22–21); on *Solanum torvum*, *Heckeria peltata*, *Phytolacca decandra* and coffee in mountains north of Yauco (234–22); on stems of fresa, *Rubus rosaefolius*, at Adjuntas (47–23); nymphs on *Heckeria peltata* at Vega Alta (106–21).

Tettigonia sirena Stal

Smyth 19–145: on "sugar cane, citrus, coffee, sesame, garden plants.

Wolcott 21–20, fig. 6: on gramma grass. *Stenotaphrum secunda-*

tum, and Bougainvillea vine at Pt. Cangrejos; on sugar cane at many points.

Tower 22–24: unsuccessfully used in transmission of mosaic disease of sugar cane experiments.

on malojillo grass, *Panicum barbinode*, (439–16, 519–17), on weeds (430–17), on *Urena lobata* (150–17), on sesame (771–11), on carrots (574–17, 529–17), on *Agati grandiflora* (156–21); on grapefruit at Vega Baja (534–16); on ganduli, *Cajanus cajan*, at Comerío (760–13 det. Heidemann, 770–13); on coffee at Lares (290–21), at Ciales (224–22); on weeds at Bayamón (509–17); on sugar cane at Hormigueros (35–22), at Bayamón, Barceloneta, Córsica, Adjuntas and Guánica (GNW).

Kolla fasciata Walker

(as *K. fuscolincella* Fowler) Wolcott 21–22, fig. 7: on St. Augustine, Bermuda and carpet grass, on sugar cane and malojillo grass, commonest in the hills. Illustration of adult.

on carpet grass in coffee grove at Ciales (63–21); on sugar cane at Toa Alta (450–21), at Corozal (GNW — det. as *Tettigonia arculifera* by Mr. Gibson), at Río Piedras and Coloso (GNW).

Kolla similis Walker

(as *Tettigonia*) Van Dine 11–31; Van Dine 12–22; Van Dine 13–257: on sugar cane.

Smyth 18–118; Smyth 19–145: on malojillo grass and young sugar cane.

Smyth 19–99; Tower 22–24; Wolcott 23–45: unsuccessfully used in mosaic disease of sugar cane transmission experiments.

Wolcott 21–22 to 28, fig. 8: the most extended account; life history and abundance as affected by size of cane, contour of field, and rainfall. Illustration of adult and nymph.

Chardón 23–64 to 67: abundance in fields of young cane where mosaic disease is spreading.

on sugar cane (218–13, 286–19), at Naguabo (35–10 det. Heidemann as *Tettigonia*), at Fortuna (54–10), at Hormigueros (36–22), at Toa Alta (453–21); on grass in coffee grove at Ciales (62–21); on weeds (429–17, 516–17), on corn (447–17), on carrots (530–17), on beans (202–16). Nymphs on sugar cane (164–19, 221–19), eggs in leaves of sugar cane (319–12, 287–19), parasitized by *Brachistella prima* Perkins, *Ufens niger* Ashmead and *Oligosita comosipennis* Girault (335–12 det. Girault).

Draeculacephala sagittifera Uhler—det. Metcalf

Wolcott 21–28, fig. 10: on sugar cane, not abundant.

on sugar cane at Hormigueros (33–22), at Guánica (139–21); nymphs and adults common on Bermuda grass (260–21), at Aguada (GNW).

Xerophloea viridis Fabricius—det. McAtee
common on carrots (528–17, 684–17); on grass at Aguadilla (232–22); at light at Yauco (304–21).

Xestocephalus pulicarius Van Duzee—det. Metcalf
on coffee (78–21), at Lares (392–21); at light at Pt. Cangrejos (GNW).

Spangbergiella vulnerata Uhler
Wolcott 21–29: from sugar cane and malojillo grass, rare.
swept from weeds (432–17), at light (GNW).

Scaphoideus fasciatus Osborn—det. Ball
Wolcott 21–31: on sugar cane at Bayamón, at light at Pt. Cangrejos.
at light (329–21).
(See page 262.)

Scaphoideus bimarginatus sp. nov. DeLong
Resembling *auroniteus* Provancher in general appearance, but with two parallel bands above, and one beneath the ocelli. Length 4 mm.

Vertex very bluntly angled, a little wider between the eyes than length at middle. Pronotum longer than vertex, twice wider than long. Elytra little longer than abdomen.

Color: Vertex dull golden yellow, a curved band just above ocelli and parallel to anterior margin, a second one just posterior to it and as far distant as the width of the first, the space between silvery white. Pronotum and scutellum golden yellow, mottled with brown. Elytra pale brownish, subhyaline, veins and a few small areas dull brown. Face with a heavy black band just below ocelli, a narrow pale band beneath it, the remainder of the face pale brown shading to yellow on clypeus with no indication of arcs. Beneath yellow, marked with brown.

Genitalia: *Female* last ventral segment about twice as long as preceding, lateral margins short, gradually produced to form a broad, short median tooth.

described from one female collected at light at Pt. Cangrejos, Feb. 27, 1920 (GNW).

Platymetopius sp.
on string beans (207–16).

Deltocephalus flavicosta Stal—det. DeLong
(as *D. contestus* Uhler MS) Gundlach.
(as *D. senilis* Uhler — det. Metcalf) Wolcott 21–29, fig. 11: on sugar cane and malojillo grass.
at light (569–17), on carrots (541–17, 538–17, 685–17); on sugar cane at Hormigueros (34–22).

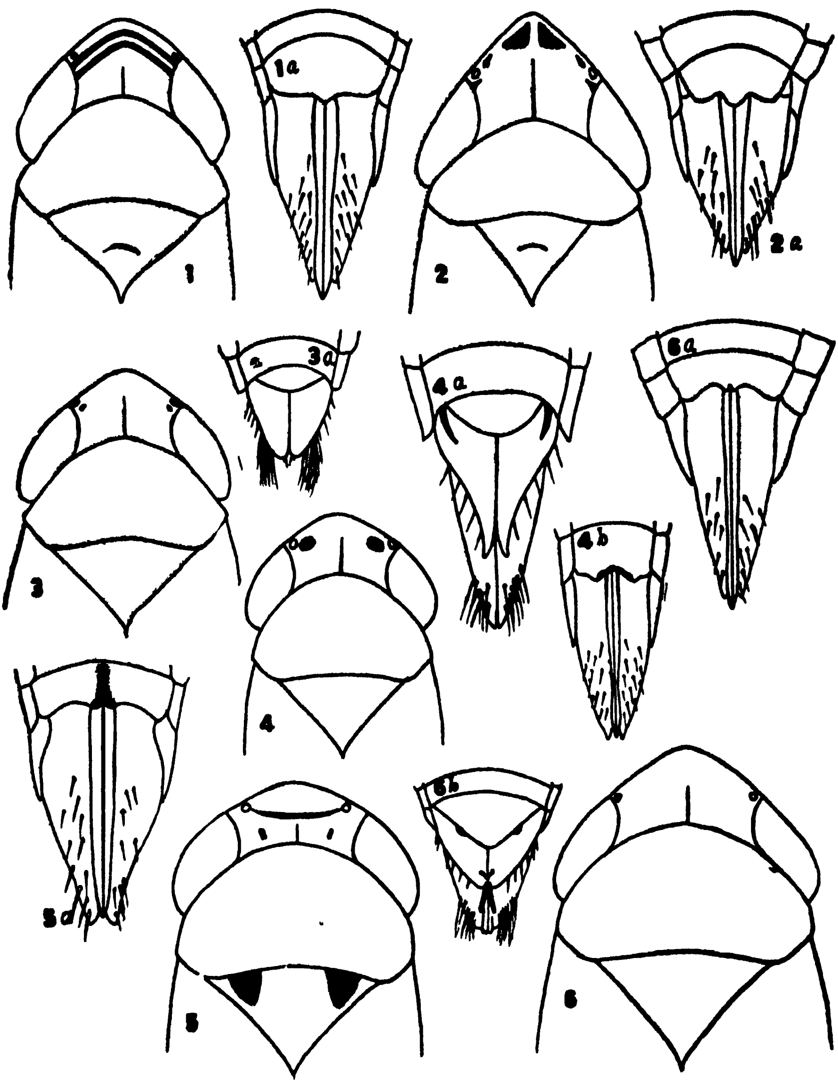

PLATE 1.—1. *Scaphoideus bimarginatus:* 1 *a,* female genitalia. 2. *Deltocephalus trilobatus;* 2 *a,* female genitalia. 3. *Deltocephalus nigripennis:* 3 *a,* male genitalia. 4. *Cicadula maidis:* 4 *a,* male genitalia; 4 *b,* female genitalia. 5. *Chlorotettix nigromaculatus:* 5 *a,* female genitalia. 6. *Chlorotettix bidentatus:* 6 *a,* female genitalia; 6 *b,* male genitalia. (Original. Drawn by D. L. DeLong.)

Deltocephalus sonorus Ball—det. DeLong
on malojillo grass at Pt. Cangrejos (GNW).

Deltocephalus trilobatus sp. nov. DeLong

Resembling *D. micarius* Ball in form, size and coloration. Vertex more produced and genitalia distinct. Length 2.5 mm.

Vertex distinctly angled, a little longer on middle than between eyes. Pronotum shorter than vertex, twice wider than long. Elytra with clavus reticulate; central anteapical cell constricted and divided.

Color: Vertex dull yellow with a pair of orange triangular spots at apex and two small brownish spots just above either ocellus. Median impressed line brown. A darker longitudinal area extends back on either side, crossing pronotum and terminating on basal angles of scutellum. Two other longitudinal stripes on pronotum lateral of the central pair. Elytra dull yellow, veins more or less heavily infuscated. Face brownish with traces of pale arcs Beneath, yellow marked with brown.

Genitalia: *Female* last ventral segment about as long as preceeding, side margins very short, lateral angles produced and rounded, between which, the posterior margin gradually slopes to a slight emargination on either side of a rounded, rather broad, but short median tooth which scarcely exceeds lateral angles in length. Underlying membranes conspicuous at either side.

described from a single female at light at Pt. Cangrejos, Dec. 16, 1919 (GNW).

Deltocephalus nigripennis sp. nov. DeLong

In general appearance somewhat resembling the *nigrifrons* group, but with coloration and genitalia distinct. Length 4 mm.

Vertex roundingly produced, more than one-fourth wider between eyes than length at middle. Pronotum one-fourth longer than vertex and almost twice as wide as long. Elytra with central anteapical cell produced anteriorly and posteriorly beyond inner and outer anteapicals, and very much longer than outer cell.

Color: Vertex, pronotum and scutellum bright green tinged with yellow, a small black area on lateral margins on pronotum. Elytra, whitish, subhyaline, almost covered with black; a broad stripe along claval and commissural line to tip of clavus and a transverse band just before tip of clavus whitish, remainder black. Face black with only a few traces of pale arcs. Venter black, lateral margins yellow.

Genitalia: *Male* valve two-thirds as long as preceeding segment, rather broad, convexly rounded. Plates together at base one-fourth wider than long, gradually sloping to blunt, rather

broadly rounded apices. Tips with tufts of whitish pubescence.

described from one male swept from grass at Boquerón (98–Feb. 21, 1923 GNW).

Euscelis (Athysanus) striolus Fallen—det. DeLong
on malojillo grass at Pt. Cangrejos (GNW).

Athysanus exitiosus Uhler—det. Ball
Wolcott 21–30, fig 12: on sugar cane at Patillas and Hatillo, rare.

Acinopterus acuminatus Van Duzee—det. DeLong
swept from grass at Boquerón (99–23).

Thamnotettix colonus Uhler—det. Metcalf
Wolcott 21–30, fig. 13: on sugar cane and malojillo grass, but commonest on carpet grass, *Axonopus compressus*, in the hills.
(as *Tettigonia similis* Walker — a misidentification) Johnston 15–23: killed by *Empusa muscae* (provisional determination).
on sugar cane (654–12), on grass (451–16), on tobacco (1153–16)

Thamnotettix nigrifrons Forbes—det. GNW
on carrots (532–17).

Thamnotettix comatus Ball (?)—det. DeLong
Two large and four small black spots on vertex
on carrots (532–17).

Chlorotettix viridius Van Duzee—det. DeLong
at light at Pt. Cangrejos (GNW)

Chlorotettix bidentatus sp. nov. DeLong
Resembling *minimus* Baker in size and form, but genitalia are distinct. Length 3.5 — 4 mm.

Vertex bluntly angled, about one-fourth longer on middle than next eyes and almost twice as wide between eyes as length at middle. Pronotum not quite twice as long as vertex.

Color: Dull yellowish-green, unmarked.

Genitalia: *Female* last ventral segment about as long as preceding, lateral angles produced and rounding, posterior margin shallowly excavated to a short, broadly-rounded median tooth, notched at apex. Whole tooth broadly embrowned. *Male* valve roundingly produced, bluntly angled, more than twice as long as preceding segment and almost twice as broad as long. Plates exceeding valve by one-third its length, strongly convexly rounded to rather appressed blunt apices, greatly exceeded by pygofers.

described from two females and one male, at light at Pt. Cangrejos, Dec. 16, 1919, Feb. 8 and 26, 1920, and one female

on sugar cane at Guánica, Dec. 10, 1919 (GNW). TYPE specimen is a female.

(as sp.) Wolcott 21–31, fig. 15: on sugar cane at many places, and at light at Pt. Cangrejos.

on weeds (567–16), at Humacao (689–17); on sweet potato (201–17).

Chlorotettix sp. nov. (undescribed)

Wolcott 21–32, fig. 16: on sugar cane at Guánica and Patillas; at light at Pt. Cangrejos.

Chlorotettix nigromaculatus sp. nov. DeLong & Wolcott

One of the round-headed species, yellowish-green with brown markings. Length 4.5 mm.

Vertex well rounded in front, slightly longer on middle than next eyes and almost twice as wide between eyes as length at middle. Pronotum twice as long as vertex and almost twice as long. Elytra rather long, appearing wedge-shaped when folded.

Color: Vertex yellowish-green, ocelli large, reddish, a transverse brown band just above them not reaching eyes. A pair of large round black spots on rounded margin just below ocelli. Face yellowish with slight traces of arcs. Pronotum yellowish, unmarked. Scutellum with a large subtriangular dark brown spot in each basal angle extending under the pronotum. Elytra whitish, hyaline, nervules milky white, two oblique brown stripes on inner clavus between veins and a broader one between claval vein and corium. Some of the cells of corium yellowish.

Genitalia: *Female* last ventral segment one-half longer than preceding, lateral angles produced, posterior margin shallowly concavely rounded and slightly notched at middle. A median brown stripe extends to base of segment.

described from a single female at light at Río Piedras (326–Oct. 10, 1922 GNW).

Jassus obligatus Uhler—det. McAtee

on leaves of *Ficus laevigata* at Quebradillas (221–21).

Cicadula sexnotata Fallen

Wolcott 21–31: on sugar cane at Patillas and Garrochales.

Cicadula maidis sp. nov. DeLong & Wolcott

In coloration resembling a very pale *variata* Fallen, elytra long, resembling *Thamnotettix fitchii* Van Duzee, but with typical *Cicadula* veination. Length 3.5 — 4 mm.

Vertex roundingly produced, thick, about one-third wider between eyes than length at middle; pronotum one-half longer than vertex, very strongly convexly rounded anteriorly; elytra long, greatly exceeding abdomen in both sexes.

Color: Straw yellow, vertex with a pair of large round

black spots, one just behind each ocellus; frequently a small spot at tip of vertex, median impressed line and four spots at base a darker yellow. Pronotum with an indication of longitudinal vittae. Basal angles of scutellum a darker yellow. Elytra yellowish, subhyaline, veins lighter.

Genitalia: *Female* last ventral segment longer than preceding, posterior margin slightly produced on either side of a broad, rather shallow, median V-shaped notch, which is slightly embrowned. *Male* valve as long as preceding segment, convexly rounded. Plates exceeding valve by more than twice its length, broad at base, concavely narrowed at half their length to form narrow, rather sharp-pointed apices. A brown mark near outer margin of either plate at base. Pygofers exceeding plates.

adults and nymphs abundant on corn (448–17 TYPE), at San Sebastián (102–21), (at Haina, Santo Domingo, August 1920, GNW); on sugar cane (645–12), on carrots (540–17). Corn the normal and common host.

Eugnathodus bisinuatus sp. nov. DeLong

In coloration resembling *Balclutha osborni* Van Duzee, but with vertex as wide or wider than pronotum and with distinct genitalia. Length 3 — 3.5 mm.

Vertex broadly rounded, almost parallel margined, three and one-half times as wide between eyes as length at middle. Pronotum more than three times as long as vertex. Elytra long, greatly exceeding abdomen.

Color: Bright green without definite markings. Eyes dark; elytra greenish, subhyaline. Beneath yellow to bright green.

Genitalia: *Female* last ventral segment about as long as preceding, posterior margin bisinuate, forming three rather distinct lobes. A brown line indicates a more distinct trilobate condition, which is apparently covered posteriorly by a thin membranous portion. *Male* valve triangular, tip blunt or truncate. Plates exceeding valve by one and one-half times its length, short and broad, broadly rounded at apex. A rather long narrow process extends dorsally from the dorsal surface of each plate.

described from a large series of specimens from seed heads of malojillo grass, *Panicum barbinode*, at Río Piedras, March 2, 1923 (GNW).

(as *Balclutha* sp. *(Gnathodus)* in part, and also as No. 49, "not yet determined") Smyth 19–107, and 19–146: on sugar cane and malojillo grass seed-heads (the name given by Smyth for "malojillo", *Eriochloa subglabra*, is not a synonym of *Panicum barbinode*, but both grasses are called "malojillo" in Porto Rico, being similar in appearance and often growing together.)

(as *Balclutha osborni* Van Duzee) Wolcott 21–32: on sugar cane and malojillo grass.

on sweet potato (202–17), on carrots (448–17), on sedge, *Cyperus ferox* (222–13 det. as *Gnathodus* sp. by Mr. Gibson), on Bermuda grass (261–21), on sugar cane (298–19, 218–19, 546–16), on sugar cane or malojillo at Coloso, Vega Alta, Manatí and Bayaney (GNW).

Eugnathodus guajanae sp. nov. DeLong

Resembling *E. abdominalis* Van Duzee in form and coloration, but with distinct genitalia. Length 3.5 — 4 mm.

Vertex broadly rounded, almost parallel margined, about four times as wide between eyes as length at middle. Pronotum three and one-half times as long as vertex. Abdomen extending only slightly beyond apex of clavus.

Color: Yellow to pale brownish, often tinged with pink. In well marked specimens, the brownish or pink longitudinal vittae are distinct and cross vertex and pronotum. Elytra milky white, subhyaline, often tinged with pink. Beneath yellowish.

Genitalia: *Female* last ventral segment about twice as long as preceding, posterior margin rather deeply and narrowly notched at middle, forming two broadly-rounded lobes. *Male* valve triangular, apex blunt. Plates convexly rounded, apices narrowed, up-turned tips often visible from beneath. Pygofers exceeding plates in length.

described from a series from arrows of sugar cane or "guajanas" at Río Piedras (377–22).

(as "Cane Seed-Head Leafhopper" (*Balclutha* sp.) in part) Smyth 19–107: "In December and January it occurred in the greatest abundance in the seed tassels of such cane plants as bore seed, and is believed to have been a principal cause of the low fertility of the seed. For this reason it may be a serious retarding factor in production of new cane varieties. The nymphs, which are dark in color with lighter dorsal stripe, could be shaken by thousands from a single cane seed tassel. They are heavily preyed upon by larvae of a Syrphid fly" (*Allograpta limbata* Fabr.).

on sugar cane at Aguadilla (31–22), at Vega Alta (Jan. 21, 1920 GNW) and from Vieques Island (Dec. 20, 1919 GNW).

(See page 268.)

Protalebra brasilensis Baker—det. DeLong

(as *Erythronura comes* Say) Wolcott 21–31, fig. 14: on sugar cane and *Wedelia trilobata,* notes on nymphs.

on carrots (533–17, 572–17, 683–17).

Alebra aureovittatus sp. nov. DeLong

Size and form of *curvilineata* with distinct coloration. Length 3 mm.

Vertex rather long and conical, very narrow between the

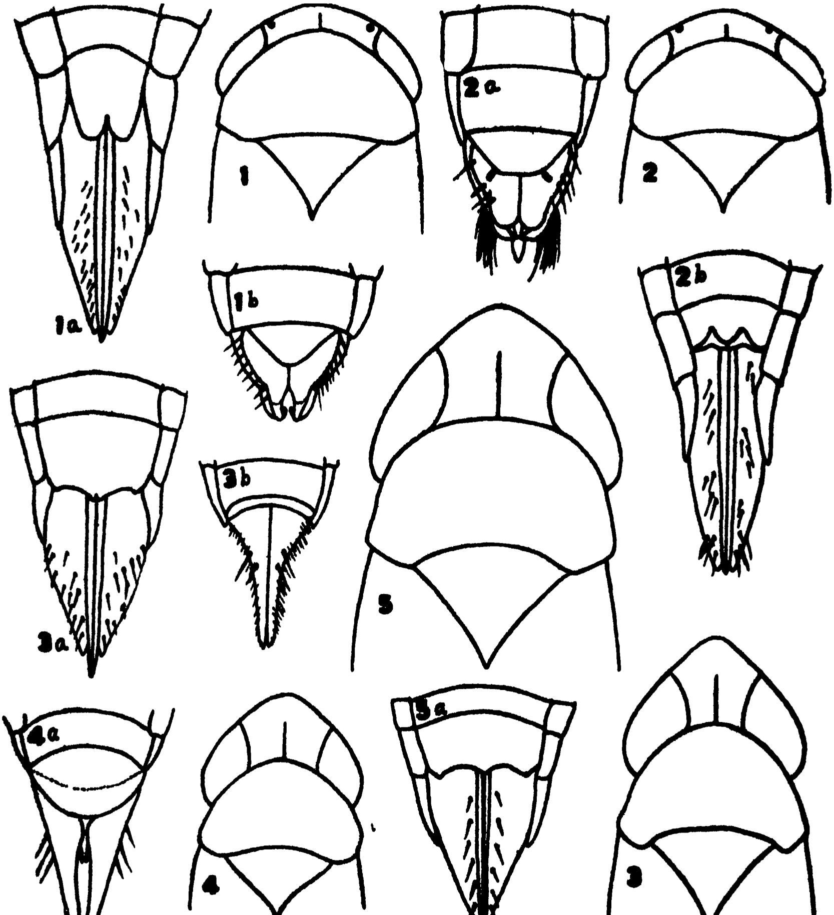

PLATE 2.—1, *Euganthodus guajanae* 1 *a*, female genitalia; 1 *b*, male genitalia. 2, *Eugnathodus bisinatus:* 2 *a*, male genitalia; 2 *b*, female genitalia. 3, *Alebra aureovittatus:* 3 *a*, female segment; 3 *b*, male genitalia. 4, *Empoasca sexmaculata*· 4 *a*, male genitalia. 5, *Empoasca brevidens*· 5 *a*, male genitalia (Original Drawn by D L DeLong.)

eyes, almost one-half longer on middle than width between the eyes. Pronotum wider than head, twice as wide as long, longer than vertex, posterior margin strongly concave, humeral angles prominent; scutellum proportionately large. Elytra much longer than abdomen.

Color: Vertex, pronotum and scutellum white, disc of pronotum bright yellow. Elytra white, a broad commisural line reaching to apex of clavus, outer claval vein and apex usually marked with yellow; a smoky spot on tip of clavus, one usually on costal area two-thirds the distance to apex and a round, dark brown spot on basal portion of central apical cell.

Genitalia: *Female* last ventral segment longer than preceding, lateral margins rounded to posterior margin, which is gradually produced to a central, angular, toothed portion. *Male* valve very short, longest at sides, concavely rounded. Plates rather narrow, extremely long, concavely rounded and produced about five times length of last ventral segment, set with numerous white hairs and each armed with two large black spines at about its middle.

described from a series of three females and four males, from underside of leaves of shoots of undetermined tree at Ciales (221–Aug. 22, 1922 GNW).

Empoasca brevidens sp. nov. DeLong

Vertex roundingly, almost conically, produced, as long as width at middle, ocelli large and readily seen from above. Pronotum longer than vertex and more than twice as wide as long. Elytra rather long, greatly exceeding the abdomen. Veination of underwings rather unique: although there is only one closed cell, there is one open cell on the costal apical portion.

Color: Vertex, eyes, pronotum, scutellum and dorsum of body are shining black. Elytra smoky green at base, tips smoky, subhyaline. Face dull reddish above, yellow below. Ventral portion of thorax yellow, of abdomen shining black, last two segments milky white.

Genitalia: *Female* last ventral segment rather long, lateral angles prominent, posterior margin slightly excavated and produced at middle.

described from a single female from mountains north of Yauco on young coffee leaves (244–August 24, 1922 GNW). This species is quite distinct from other *Empoasca*, especially in wing veination and structure of the head.

Empoasca mali Le Baron (redetermined as **E. flavescens** Fabricius by DeLong)

Barrett 04–448: "severest insect enemy of beans and cowpeas."

Jones 15–3: "acute injury to garden beans, the leaves being badly curled and distorted."

Cotton 18–276: on a "great variety of plants", "great damage to bean".

Wolcott 21–33: "on cane when beans are growing between the rows."

on beans (406–13, 445–16, 480–16, 636–17, 444–17), on tobacco (1154–16), on carrots (534–17), beets (407–19), on sweet potatoes (449–17), all stages abundant on *Agati grandiflora,* causing yellowing and shedding of leaves (154–21 confirmed DeLong).

Empoasca sexmaculata sp. nov. DeLong

Resembling *mali,* but with vertex more angulate and with brown spots on elytra. Length 2.3 mm.

Vertex bluntly, angularly produced, almost as long as width between eyes. Pronotum with prominent humeral angles. Elytra greatly exceeding abdomen. No cross vein in wing forming a short closed cell as in typical *Empoasca* species.

Color: Pale white to yellow, slightly tinted with green. A pale orange area close to base on costa, a large round spot on clavus just back of scutellum, a paler one just back of apex of clavus and a third one, pale, on inner margin of inner apical cell, brown. Face and beneath white, tinted with yellow.

Genitalia: *Female* last ventral segment rather long, roundingly produced, posterior margin rather broadly embrowned. *Male* valve roundingly produced, longer than last ventral segment. Plates rather narrow and greatly elongated, their inner margins turned in, to form tubular structures which are produced upwards.

described from a pair, on "emajagua", *Partium tiliaceum,* at Pt. Cangrejos, (Jan. 13, and May 29, 1920 GNW), causing yellowing of the leaves. Large and small nymphs present.

The male genitalia are very distinct from other Empoascas.

FULGORIDAE.[1]

Bothriocera venosa Fowler—det. Muir

(as sp. on *Palicourea crocea*) Stevenson 18–218: host of *Isaria saussurei* Cooke.

(as sp.) Smyth 19–146: on *Citrus* spp., *Palicourea* spp., *Anona* spp., *Piper aduncum,* sugar cane rarely; also from Vieques Island.

Wolcott 21–19: rare on cane, common on wild orange at Pt. Cangrejos.

(294–12, 618–16, 824–16), at light (149–17), on grapefruit (809–16, 33–20, 66–20); on *Banisteria laurifolia* at Martin Peña (843–14); on *Inga vera* at Añasco (341–13); on *Inga laurina* at Lares (147–22); common on coffee at Corozal, Ciales, Lares and Yauco (291–21); nymphs at Ciales, brown with

[1] Mr. Muir is publishing descriptions of several new species of Fulgoridae from Porto Rico in the Proceedings of the Hawaiian Entomological Society for 1923 (1924).

warts on head and thorax and with long irridescent spicules at caudum, and also swept from grass in coffee grove (61–21); on coffee, *Heckeria peltata* and very common on unidentified plant, many killed by fungus, in mountains north of Yauco (84–22).

Oliarus cinereus Wolcott 21–18, fig. 4, TYPE from Porto Rico: adults, singly or in coitu, common on cane, especially at Manatí and Sardinera.

(as sp.) Wetmore 16–66: eaten by Tody, *Todus mexicanus.*

(as sp.) Smyth 19–147: "Cotton-tail plant-hopper — quite common on young cane."

Tower 22–24: unsuccessfully used in transmission of mosaic disease of sugar cane experiments.

on tomato (1152–16), on carrots (536–17), on beans (205–16), on corn (517–17), on eggplant (RTC); on sugar cane (132–11, 143–11, 661–12), at Toa Baja (445–21, 256–22), at Guánica (40–22); constituting 5% of food of lizzard, *Anolis pulchellus* (GNW).

Tangia angustata Uhler—det. McAtee

on *Inga vera* (83–21); on coffee at Cayey (409–21); on pokeweed, *Phytolacca decandra,* and on *Heckeria peltata* in mountains north of Yauco (313–21); the green nymphs, with brush of widely-diverging, transparent-irridescent spicules at caudum, reared to adult on coffee (93–21), on *Erythrina glauca* (39–21) by Mr. Seín; on wild orange at Jajome Alto (23–21).

Tangia sp. (smaller)

on grapefruit at Vega Baja (531–16); on sea-grape, *Coccoloba uvifera* at Loíza (126–22).

Thionia sp.—det. Muir

nymphs abundant, and a few adults, on sea-grape, *Coccoloba uvifera,* at Loíza (122–22), at Mameyes (340–22).

Acanalonia sp. nov.—det. Muir, "near **depressa** Melichar"

on shrub in woods at Seboruco, Laguna de San José (234–23).

Ormenis infuscata Stal—det. Heidemann

all stages on sugar cane, under and on aguacate, *Persea gratissima* (674–12); adults on grapefruit at Vega Baja (518–16), at Vega Alta (157–15); on coffee at Lares (150–20).

Ormenis marginata Brunnich—det. Heidemann

(128–12), on sea-grape, *Coccoloba uvifera* (138–15); on *Lantana camara* at Carolina (51–15); on coffee at Utuado (148–20), at Corozal (295–21); on weeds at Vega Alta (127–17); on ornamental vine at Santa Isabel (183–12, 71–13).

Ormenis pygmaea Fabricius—det. Heidemann

Van Z. (606) on coffee.

(127–12), on *Jasminium pubescens* (268–16), on *Cordia cor-*

ymbosa (273–12), on coffee (173–21, 14–22 reared, eggs laid Sept. 1, 1921, hatched Sept. 12, first adult noted Dec. 1, fifteen on Jan. 15, 1922, one adult lived nearly a year), at Utuado (149–20, 138–20); on *Piper medium* at Vega Alta (128–17); on ornamental vine at Santa Isabel (71–13, 183–12); on sea-grape, *Coccoloba uvifera,* at San Juan (138–15, 129–15), at Pt. Salinas (232–16); on *Lantana camara* at Carolina (51–15); on sea-grape and very abundant on *Lantana camara* at Isabela and Hatillo (206–21); at light at Guánica (664–13), and on *Cordia cylindrostacha* (522–13, 293–16).

Ormenis quadripunctata Fabricius—det. Muir

(as sp.) Van Dine 13–257; Smyth 19–147: "found breeding on cane leaves in one instance."

all stages on sugar cane (under) and on aguacate tree (674–12 det. Heidemann); on *Cordia corymbosa* (273–12); on grapefruit (64–20), at Plantaje (32–16), at Sabana Llana (128–15), at Vega Baja (519–16), at Espinosa (507–17); on *Lantana camara* at Martin Peña (841–14), at Mameyes (341–22), at Guánica (GNW — det. Muir); on castor bean at Luquillo (95–16); on sea-grape at Isabela (205–21).

Ormenis spp. (refering to some or all of the above species)

Wetmore 16–66, 71, - - - - 128: eaten by Tody, Hummingbirds, Flycatcher, Pewee, Cliff Swallow, Vireos, Redstart, five Warblers, Honey Creeper, Mozambique and Grasshopper Sparrow.

Cyarda sp.

Wolcott 23–46: on coffee.

on sea-grape, *Coccoloba uvifera,* at Pt. Cangrejos (397–22); on wild Bougainvillea vine at Cayey (360–22); on grapefruit at Vega Alta (129–17), at Vega Baja (530–16); on coffee at Utuado (475–21, 252–22), at Corozal (458–21), at Lares, Yauco, Ciales and Corozal (288–21).

Flatoides sp.

on coffee at Maricao (406–21), at Aibonito (RTC)

Flatoides sp.

at light (321–22); on trunk of sea-grape at Isabela (204–21).

Neocenchrea sp.—det. Muir

on unidentified palm in mountains north of Yauco (236–22) in great abundance. Adults light yellow with white bloom, a black spot at inner angle of forewing and two or more small ones at tip on outer margin.

Ugyops sp.—det. Muir

on trunk of *Inga laurina* at Lares (639–21, 108–22), at Adjuntas (271–22): on trunk of coffee tree in mountains north of Yauco (238–22).

Saccharosydne saccharivora Westwood
(as *Delphax*) Van Dine 12–20 to 22: on sugar cane, early references, collections in Porto Rico, life history and parasites.
(as *Delphax*) Van Dine 13–256; Van Dine 13–32; Van Z. (309) on sugar cane.
(as *Stenocranus*) Smyth 19–147: on sugar cane.
(as *Delphax*) Jones 14–463: eggs parasitized by a Mymarid, identified as *Anagris armatus* Ashmead by Mr. Girault.
(as *Stenocranus*) Pierce, W. Dwight, *in* Proc. Ent. Soc. Washington, Vol. 16, No. 3, Sept. 1914, p. 126: host of a new genus and a new species of Strepsiptera, *Stenocranophilus quadratus*.
(as *Delphax*) Wolcott 21–14, fig. 2: life history and abundance. Illustration of adult and nymph.
(as *Stenocranus (Delphax)*) Tower 22–24: unsuccessfully used in mosaic disease of sugar cane transmission experiments.
on sugar cane (123–11, 141–11, 974–13, 165–19, 242–19, 157–21), at Luquillo (196–13), at Arecibo (186–11), at San Sebastián (21–22), at Guánica (238–11), throughout the Island but rare on south side.

Neomalaxa flava Muir—det. Muir
on cohitre grass, *Commelina elegans*, at Ciales (278–21), at Lares and generally in the mountains. The nymphs produce five long filaments from the caudum, besides many smaller ones, and fine threads from the thorax.

Nilaparvata wolcotti Muir MS, TYPE from Porto Rico.
on malojillo grass at Pt. Cangrejos (GNW).

Sogota cubanus Crawford—det. Muir
(as *Megamelus flavolineatus* Muir) Wolcott 21–18, fig. 3: on sugar cane, both nymphs and adults.
(as *Perkinsiella* sp. "White-lined plant-hopper") Smyth 19–148: on sugar cane, rice and grasses.
on rice (41–20), on carrots (573–17, 535–17); on sugar cane at Toa Baja (286–21, 446–21).

Sogota approximata Crawford—det. Muir
on malojillo grass at Pt. Cangrejos (GNW); on grasses in cane fields at Toa Baja (447–21).

Peregrinus maidis Ashmead—det. Heidemann
Jones 15–2: on corn. Cotton 18–291: life history and control.
all stages on corn (532–12, 278–16, 446–17, 42–20), a common and rather serious pest; a single adult from leaf of sugar cane at Santa Isabel (72–13).

Delphacodes havanensis Crawford—det. Muir
on malojillo grass at Pt. Cangrejos (GNW).

Delphacodes humilis Van Duzee—det. Muir
on malojillo grass at Pt. Cangrejos (GNW); on guinea grass, *Paspalum hemisphaericum*, (107–12, 444–12 det. as "near *humilis*" by Mr. Heidemann).

Delphacodes propinqua Fieber—det. Muir
on malojillo grass at Pt. Cangrejos (GNW).

Delphacodes teapae Fowler—det. Muir
(as *Liburnia*) Wolcott 21–18: at light, on sugar cane, on malojillo and carpet grasses.
on carrots (542–17, 576–17); on carpet grass, *Axonopus compressus*, in coffee grove at Ciales (66–21); on malojillo grass at Mayagüez (38–23).

Ladella pallida Walker, TYPE from Porto Rico.
on malojillo grass at Río Piedras (March 31, 1920 GNW—det. Dr. H. L. Dozier).

PSYLLIDÆ.

Psylla minuticona Crawford—det. McAtee
common on *Inga vera* at Lares (163–22) and throughout the coffee districts.

Euphalerus nidifex Schwarz—det. McAtee
adults on watershoots of *Ichthyomethia (Piscidia) piscipula* at Yauco (324–23); whitish nymphal skins common on host at Boquerón and Pt. Cangrejos (GNW).

Heteropsylla mimosae Crawford—det. McAtee
very abundant on *Acacia farnesiana* at Guánica and Guayanilla (GNW), at Guánica (103–13).
(undetermined Psyllids on *Pithecolobium saman* (431–16)).

ALEYRODIDÆ.

LITERATURE.

Quaintance, A. L. & Baker, A. C., "Classification of the *Aleyrodidae*, Part 1 & 2", Bull. 27, Bur. Ent. (Technical Series) U. S. Dept. Agr., Washington, D. C., March 6, 1913.

Cotton, R. T., "*Aleyrodes citri* not in Porto Rico" *in* Jour. Ec. Ent., Vol. 10, No. 3, June, 1917, p. 377.

Aleurothrixus floccosus Maskell
(material in U. S. Bureau of Entomology collection.)

Aleurothrixus howardi Quaintance
(as *Aleyrodes*) Tower 11–11: on guava and orange, life history and control.

Van Z. (4) on guava and orange. Cotton 17–377: on guava.
on orange at Pueblo Viejo (302–12); on grapefruit (898–14, 775–19), at Vega Alta (123–17); on *Citrus decumang* at Espinosa (82–15); on guava, *Psidium guajava*, (753–13 det. Quaintance).

Aleurodes trachoides Back
Van Z. (911) on *Solanum nigrum*, *S. seaforthianum*, eggplant, tomato and pepper.
on *Solanum torvum* (65–17), (determination doubtful, on tobacco (378–17)).

Aleurodicus sp. nov.—det. Quaintance
on *Myrcia* sp. at Pt. Cangrejos (7–15); on *Eugenia buxifolia* at Pt. Cangrejos (975–13, 49–15, 163–15) and on *E. latibunda* (50–15).

Aleurodicus (Metaleurodicus) minimus Quaintance, A. L., Contributions toward a Monograph of the American Aleurodidae'', Bull. 8, Bur. Ent. (Technical Series) U. S. Dept. Agr., pp. 43–47, pl. vi, figs. 63–67, 1900, TYPE from Porto Rico: ''on *Guayava* sp.'' ''a large number killed by a fungus.''
Quaintance and Baker 13–77: generic transfer to *Metaleurodicus*.
Cotton 17–377: on guava.
Johnston 15-11; Stevenson 18–218: host of *Aegerita webberi* Faw.
Johnston 15–12 to 14; Stevenson 18–203: host of *Aschersonia aleyrodi* Webber and *A. flavo-citrina* P. Henn.
on *Psidium guajava* (115–12, 211–12, 379–13, 754–13 det. Quaintance), at Arecibo (230–19).

Bemisia sp., ''probably new''—det. Quaintance
on *Euphorbia hypericifolia* (23–15).

Dialeurodes busckii Quaintance & Baker, TYPE from Porto Rico.

Leonardius lahillei Leonardi
Quaintance & Baker 13–39 to 41, pl. ix: on *Phoradendron* parasitic on almond at Mayagüez; redescribed and figured.
Van Z. (1617) on *Phoradendron* sp.

Tetraleurodes ursorum Cockerell, T. D. A., TYPE from Porto Rico: collected by August Busck, Jan. 12, 1899, on *Coccoloba* sp.
undetermined Aleyrodidae on *Canna* sp. (1155–16, 269–16); on *Scoparia dulcis* (10–17); on *Bignonia unguis* (59–18); on *Bocconia frustescens* (750–13); on coconut palm (135–16).

APHIIDÆ.

LITERATURE.

Jones, Thos. H., "Aphides or Plant-Lice Attacking Sugar Cane in Porto Rico" Bull. 11, Insular Experiment Station, Río Piedras, P. R., March 15, 1915, pp. 1–19, pl. 2.

Wolcott, G. N., "Afidos de Importancia Económica en Puerto Rico" Circ. 59, Insular Experiment Station, Río Piedras, P. R., 1922, pp. 1–11, fig. 9.

Sipha flava Forbes—det. Monell & Davis

(as *S. graminis* Ktl.) Van Dine 13–257; Van Dine 13–32: on sugar cane.

Jones 14–462; Smyth 19–148; Van Z. (307), on sugar cane.

Jones 15–3: an extended account, giving predators and parasites.

Johnston 15–10; Stevenson 18–207: host of *Acrostalagmus albus* Pr.

Wolcott 21–33; Wolcott 22–4: notes, on sugar cane.

Smyth 19–103; Wolcott 21–47 (after Smyth); Tower 22–25: unsuccessfully used in transmission of mosaic disease of sugar cane experiments.

Van Zwaluwenburg 18–28: "a serious outbreak on young cane at Ponce."

Smyth 19–122: "a severe outbreak at Río Piedras and at Fortuna."

on sugar cane (328–12, 925–13), at Guánica (166–11, 515–13, 342–13), at Trujillo Alto (722–12), at Juncos (27–19), common on this host, sometimes occurring in such abundance over entire fields of young cane as to cause serious injury before the many predators and parasites can bring it under control; on sorghum (498–13), on lemon grass, *Andropogon nardus cerifer* (347–13).

Aphis maidis Fitch

Cotton 18–291: the corn leaf aphis, notes and control by insect enemies.

Wolcott 21–34: "not found on cane in Porto Rico."

Wolcott 23–45: adults found on young plant cane at Guánica, nearly half of which had mosaic disease two months later.

Chardón, C. E. & Veve, R. A., "The Transmission of Sugar-Cane Mosaic by *Aphis maidis* under Field Conditions in Porto Rico" in Phytopathology Vol. 13, No. 1, January 1923, pp. 24–29, fig. 1:

"1. *Aphis maidis* is found, with more or less abundance, in various grasses occurring in the sugar cane fields of Porto Rico.

"2. After the weeding of the fields, *Aphis maidis* passes to sugar

cane plants, living in the central whorl of leaves for a period of time.

"3. During the short time that it stays on cane, *Aphis maidis* transmits the infective substance of the sugar cane mosaic and carries the disease from diseased to healthy plants."

Chardón 23–65 to 67: the same data.

on corn (273–16 det. Wilson); on sorghum (523–12 "resemble *Aphis avenae*" Monell); on malojillo grass, *Eriochloa subglabra*, from Fajardo (142–22 det. Baker) in cages used by Chardón & Veve in mosaic transmission experiments; on sugar cane at Bayamón, in central whorl, May 5, 1920 (GNW) "only early stage nymphs present so cannot determine" A. C. Baker; adults on sugar cane at Guánica (420–21 det. Patch); constituted a sixth of the food of seven lizzards, *Anolis pulchellus*, at Río Piedras (GNW).

Aphis nerii Boyer—det. Patch

Wolcott 22–4: on *Asclepias curassavica* and *Calotropis procera*, a large yellow aphis with antennae and legs black, common on the smaller milkweed in the moister sections of the Island, and on the giant milkweed in the dryer sections.

at Lares (418–21), at Yauco (104–14).

Aphis gossypii Glover

Barrett 05–396: on cotton. Smyth 20–124: on cotton.

Jones 15–3: on cucumber, predators and parasitic insects and fungi mentioned.

Cotton 18–294: on cucumber, control by spraying.

Wolcott 22–4: on cotton and melon.

(as sp.) Stevenson 18–207: host of *Acrostalagmus albus* Pr.

on *Psidium guajava* (64–23 det. Baker), on cucumber (394–12 det. Pergande, 43–16); very destructive to honey-dew melons at Condado near the beach, but controlled by spraying when the plants were young (Lee H. Vendig); on cotton (595–16, 423–21 det. Baker), at Sabana Grande (357–21), at Isabela and Hatillo (197–21) "most abundant on fields just behind sand dunes and close to the ocean, and even in these fields, only a small number of plants were heavily infested; attended by *Prenolepis longicornis* Latr. and furnishing food for several species of predators"; on *Cecropia peltata* at Lares (97–22 det. Baker).

Brevicoryne brassicae Linnaeus

(as *Aphis*) Cotton 18–283: on cabbage, control.

on Chinese mustard (31–18).

Carolinaia cyperi Ainslie—det. Baker

Wolcott 23–45; Chardón 23–66: on *Cyperus rotundus*, a common sedge in cane fields.

(421–21), at Bayamón (422–21), at Barceloneta and Arecibo (9–22).

Hysteroneura setariae Thomas—det. Davis
(as *Aphis*) Jones 15–4: "The Brown Sugar Cane Aphis", not common and occurs in small numbers at the junction of the leaf-sheaths and blades of young cane, covered with sheds of earth built over them by ants, *Solenopsis geminata* Fabr.
(as *Aphis*) Jones 14–462; Smyth 19–148: on sugar cane.
(as *Aphis*) Wolcott 21–34: scarcity on sugar cane, notes.
on sugar cane (329–12, 696–12, 92–13, 923–13), at Loíza (DLVanD), at Mameyes (795–12), at Arroyo (DLVanD), at Manatí (GNW); on stems, leaves and spike of wire grass, *Eleusinia indica* (289–22 det. Baker).

Rhopalosiphum persicae Sulzer—det. Wilson
(as *Aphis* sp.) Stevenson 18–207: host of *Acrostalagmus albus* Pr.
Cotton 18–296: on eggplant and pappers, notes.
Wolcott 22–5: mention.
on eggplant (33–16, 52–16), on pepper (272–16, 422–16, 17–170), on sweet potatoes and sesame (809–19 det. Smyth).

Toxoptera aurantiae Boyer
(as *T. aurantii* Boyer) Van Zwaluwenburg 17–516: on young shoots of coffee, orange and "geo"; notes and control by fungus, *Acrostalagmus albus*.
Wolcott 22–6: on mamey, *Mammea americana*, coffee, cacao and *Citrus* spp., illustration of the curling of the leaves of the latter by the aphids.
on mamey and grapefruit at Plantaje (28–16), on grapefruit (34–16 det. Wilson), on *Murraya exotica* (134–17 det. Wilson); on cacao at Ciales (471–21); on mamey and seagrape at Pt. Salinas (68–22) attended by *Monomorium destructor* Jerdon; common on coffee throughout the Island, eaten by Honey Creeper, *Coereba portoricensis* (153–23) from this host.

Amphorophora lactucae Kalt.—det. Baker
on lettuce (182–19, 61–22), on wild lettuce at Adjuntas (96–22).

Macrospiphum illinoiensis Shimer (**viticola** Thomas)—det. Patch
Wolcott 22–6: on *Cissus sicyoides*.
on host (162–21, 417–21).

Macrospiphum sp.—det. Baker
on dandelion (143–22).

Pentalonia nigronervosa Coquillett—det. Baker
on cultivated *Calla* (imported) (134–22), abundant on stems of banana (280–23 det. P. W. Mason), of yautía and malanga (F. Seín).

Cerataphis lantaniae Boisduval—det. Baker
(as *Calaphis latariae*) Smyth, E. G., "Plant Inspection and Quarantine Report" Bull. 23, Insular Experiment Station,

Río Piedras, P. R., September 1919, p. 61: "a serious pest of ornamental palms at Río Piedras. Twice intercepted on orchids from Venezuela."
on Chinese fan palm, *Livistona* sp. (42–19, 44–19, 61–23).

COCCIDÆ.

LITERATURE.

Busck, A. 00–88 to 93. "Notes on a Brief Trip to Puerto Rico in January and February, 1899," including a "List of the Coccidae Collected by Mr. A. Busck in Porto Rico." By T. Pergande and T. D. A. Cockerell. Bull. 22, new series, Div. Ent. U. S. Dept. Agr., 1900. pp. 88–93.

Fernald, Mrs. M. E. 03–1 to 360. "Catalogue of the Coccidae of the World." Bull. 88, Mass. Agr. Expt. Sta., 1903. pp. 1–360.

Jones, T. H. 17–1 to 16. "A List of the Coccidae of Porto Rico." Jour. Board of Comm. of Agr., P. R., Vol. 1, No. 1, January 1917. pp. 1–16.

The section on Coccidae has been prepared by Mr. J. D. More. The paper by Mr. Thos. H. Jones, (17–1 to 16) contains all records from the Insular Experiment Station collection up to the date of its publication, but to avoid repetition, all, including the more recent records, are here listed as though all were original and only when the record given by Mr. Jones has not been found in the accession catalogue of the Station, has it been noted in the reference to his paper. Practically all the determinations for the list given by Mr. Jones were by Mr. E. R. Sasscer and E. W. Rust, but Mr. Harold Morrison and Prof. G. F. Ferris have made most of the recent determinations. In addition, records for an unpublished list by Dr. Hooker, of the Mayagüez Station, have been included.

MONOPHLEBINAE.

Icerya montserratensis Riley and Howard
Busck 00–92: on orange at Mayagüez and Bayamón.
Tower 08–38: on orange.
Van Z. (10): on orange at San Juan; on *Inga vera, Inga laurina, Byrsonima spicata, Casearia sylvestris, Cocos nucifera, Pithecolobium saman,* and *Psidium guajava.*
on *Chrysophyllum argentium* (1204A–13), *Ficus nitida* (37–21), on undetermined tree at Santurce (578–12); on citrus at Dorado (139–16); on *Calophyllum calaba,* at Point Cangrejos (261–16); on *Inga vera* at Ciales (468–21); on *Ficus nitida* at Manatí (351–21).

MARGARODINAE.

Margarodes formicarum Guilding
Wetmore 16–50, 61, 119: eaten by Ground Dove, Ani, and Mozambique.
on roots of grapefruit at Manatí (136–20 det. by More, confirmed by Morrison).

ORTHEZIINAE.

Orthezia insignis Douglas
Van Z. (2007): on *Coleus* sp., *Ipomoea fastigiata, Lantana camara,* chrysanthemum, tomato, *Hamelia patens* and *Lactuca.*
Jones 17–4: on *Bignonia* sp. and *Ipomoea tilliacea* at Río Piedras.
on *Coleus* sp. (118–16), on *Ipomoea tiliacea* at Dorado (736–13 det. Rust); on *Eupatorium odoratum* at Comerío (752–13); on *Lantana camara* at Yauco (702–14); on *Bignonia* sp. and rose-bush cuttings at Aibonito (106–15).

CONCHASPINAE.

Conchaspis angraeci Cockerell
Van Z. 17–34: on vanilla at Mayagüez. "Not likely to become important."
on branches of an ornamental croton (*Codiaeum* sp.) at Mameyes (825–12).

ASTEROLECANIINAE.

Asterolecanium aureum Boisduval
Busck 00–92: on leaves of a fiber plant, at San Juan.

Asterolecanium bambusae Boisduval
Busck 00–92: on bamboo at Bayamón and Utuado.
Van Z. (1613).
on bamboo (758–14, det. Rust), at Trujillo Alto (37–15).

Asterolecanium lanceolatum Green
on leaves of bamboo (758–14 det. Rust)

Asterolecanium pustulans Cockerell
Busck 00–92: on *Anona muricata* at San Juan, on leguminous plant at Guayama.
Barrett 03–446: on *Ficus carica* at Mayagüez.
Fernald 03–52: Porto Rico.
Van Z. (1635): on rubber, silk-oak, *Anona reticulata.*
on silver-oak, *Grevillea* sp. (410–13 det. Rust), on *Sida antillensis* (801–14), on *Jasminum sambac* (863–14), on *Bauhinia* sp. (1–17), on *Conocarpus erectus* (11–17), on Bougainvillea (55–16), on oleander (356–21 det. Wolcott, confirmed by Morrison), on *Cassia fistula* (68–23), on mulberry (526–23); on *Achras sapota* at Vieques Island (421–19); on oleander and gandulis at Pt. Cangrejos (356–21); on cotton at Maunabo (5–22 det. Ferris); on *Inga vera* at Cayey (6–23).

PSEUDOCOCCINAE.

Phenacoccus sp.

(as *Phenacoccus gossypii* Towns. and Ckll.) Busck 00–92: on cotton at Humacao, "new to the West Indies."

(as *Phenacoccus helianthi* var. *gossypii*) Maxwell-Lefroy, H., *in* "Scale Insects of the West Indies." West Indian Bul., Vol. III, No. 4, 1902, pp. 295–319, on p. 298: "Porto Rico."

Johnston 15–22; Stevenson 18–134: host of *Empusa freseni* at Río Piedras.

on *Acalypha wilkesiana* (478–12 det. Morrison); on cotton at Maunabo (5–22 det. Ferris).

Pseudococcus bromeliae Bouché

on young bud coming out from roots of sugar cane at Guánica (648–21 det. Ferris); on roots of *Cyperus rotundus* at Guánica (3–22); on banana rootlets at Corozal (GNW).

Pseudococcus calceolariae Maskell

Jones 14–461: first record from Porto Rico.

Johnston 15–14: host of *Aspergillus flavus* at Carolina, Río Piedras, Fajardo, Santa Rita, Guánica.

Johnston 15–25: host of *Isaria* sp. at Río Piedras.

Smyth 19–102: used in transmission of mosaic-disease experiment.

Smyth 19–149: on sugar cane.

Wolcott 22d–17: not eaten under field conditions by introduced lady beetle, *Cryptolaemus montrouzieri* Muls.

on internodes of sugar cane behind leaf-sheaths (852–12 det. Green).

Pseudococcus citri Risso

(as *Dactylopius*) Barrett 03–445: an enemy of citrus stock, not common.

Tower, W. V., "Control of the Brown Ant (*Solenopsis geminata* Fabr.) and the Mealy Bug (*Pseudococcus citri* Risso) in Pineapple Plantations." Circ. 7, P. R. Agric. Expt. Sta. p. 3.

Hooker 12–35, 37: in coffee plantations.

Van Z. (5): on *Ananassa ananas* and orange.

on the roots of *Apium graveolens* (531–12 det. Morrison), *Zea mays* (543–12), and a grass probably *Sporobolus jacquemontii* (554–12), on *Piper* sp. (316–22); on roots of coffee trees at Maricao (408–21 det. Morrison); on the tender twigs of coffee trees at Ciales (469–21); on *Heckeria peltata* at Yauco (89–22).

Pseudococcus longispinus Targioni

Van Z. (611): on coffee.

on "jasmín" vine (53–18 det. EGS), on grapefruit (200–19 det. EGS), on citrus (72–20 det. EGS); on "jazmín" vine at Sabana Llana (313–22 det. Ferris).

Pseudococcus nipae Maskell

Johnston 15–19: host of *Cephalosporium lecanii* at Río Piedras.

Johnston 15–21; Stevenson 18–134: host of *Empusa fresenii* at Río Piedras.

Stevenson 18–207: host of *Botrytis rileyi* at Río Piedras.

Van Z. (1201): on *Persea gratissima* and *Psidium guajava*.

on *Psidium guajava* (270–12), *Anthurium acaule* (10–14), on *Anona muricata* (289–12), on *Chrysophyllum argenteum* (583–12), on *Musa paradisiaca* var. (585–12), on *Miconia prasina* (235–13), on *Anona reticulata* (12–14), on *Tetrazygia elaeagnoides* (40–14), on *Cocos nucifera* (120–15 det. Rust), on *Anona reticulata* and Livistona palm (61–18), on *Erythrina glauca* (60–18); on *Cocos nucifera* at Santurce (215–11); on palm at Santa Isabel (427–13); on *Persea gratissima* (50–14), and *Coccoloba uvifera* (51–14) at Naguabo; on *Sterculia apetala* at Salinas (34–15); on *Cocos nucifera* at Arecibo (282–19); on *Achras sapota* at Vieques Island (423–19); on *Anona muricata* at Maricao–Mayagüez (83–22).

Pseudococcus sacchari Cockerell

(as *Dactylopius*) Busck 00–92: on sugar cane at Bayamón, Mayagüez and Humacao.

Fernald 03–109: in Porto Rico.

Van Dine 11–18, 29; Van Dine 12–19, 20; Van Dine 13–251, 252, 253, 255, 256; Van Dine 13–31: on sugar cane.

Jones 14–461: parasitized by *Karschomyia cocci* Felt.

Van Z. (310): on sugar cane.

Stevenson 18–207: host of *Aspergillus flavus* at Río Piedras, Patillas, Fajardo, Carolina and Guánica.

Smyth 19–102: used in transmission of mosaic-disease experiments.

Smyth 19–149: on sugar cane.

Wolcott 22d–17: not eaten under field conditions by *Cryptolaemus montrouzieri* Muls.

on sugar cane (2–18, 222–19, 225–19); on sugar cane under leaf-sheaths, at Guánica (13–10), at Loíza (20–10), at Vega Alta (61–10), at Fajardo (19–11), at Caguas (3–18), at Guánica (2–22 det. Ferris).

Pseudococcus virgatus Cockerell

on ornamental croton, *Codiaeum* sp. (712–17 det. Morrison), on *Hibiscus esculentus* (678–17), on *Achryanthis indica* (315–22 det. Ferris); on *Terminalia catappa* at Manatí (290–22 det. Ferris); on cotton at Vega Baja (5–23 det. Ferris).

Antonina (Chaetococcus) bambusae Maskell

Van Z. (1614): on bamboo at Mayagüez.

on bamboo, under leaf-sheaths at Mayagüez (82–22 det. Ferris).

COCCINAE.

Pulvinaria iceryi Guerin (=**P. elongata** Newstead).
Smyth 19–104: first record in Porto Rico, on sugar cane, used in transmission of mosaic disease.
Smyth 19–149: on sugar cane.
Wolcott 21–47: an apparent 6.6% success of transmission of mosaic disease of sugar cane obtained by Smyth.
Wolcott 21–35: on sugar cane.

Pulvinaria psidii Maskell
Tower 08–38: on orange and coffee.
Hooker (1250) : on *Chrysophyllum cainito,* at Mayagüez.
Van Z. (11): on orange, *Achras sapota* and mango.
Wolcott 22d–111: on *Rauwolfia nitida* at Guánica.
on *Psidium guajava* (424–12), on *Mangifera indica* (530–12), on *Spondias lutea* (545–12, 781–16); on twigs and petioles of *Citharexylum fruticosum* (62–23); on *Spondias lutea* at Arroyo (172–12); on *Rauwolfia tetraphylla* at Ponce (131–13); on *Psidium guajava* at Luquillo (922–13); on coffee at Adjuntas (493–21).

Cryptostigma (Pseudophilippia) inquilina (Newstead) Ferris
(as *Pseudophilippia inquilina*) Newstead, R., *in* Bull. Ent. Res. 10; 181 (1920): TYPE from Jamaica.
(as *Cryptostigma ingae*) Ferris, G. F., *in* Can. Ent., LIV, No. 7, July 1922, pp. 160–161, fig. 4: TYPE on *Inga laurina* at Lares, Porto Rico.
(as *Akermes secretus*) Morrison, H., *in* Psyche, Vol. XXIX, No. 4, August 1922, pp. 145–748, Pl. VI, fig. 20–31: HOLOTYPE and PARATYPES on *Inga laurina* at Mayagüez; PARATYPES on "guama" at San Juan.
(as a pinkish scale), Tower 11–32: in coffee shade trees.
(as a pink scale of the subfamily *Coccinae*) Hooker 13–35: on *Inga laurina* and coffee.
(as an undetermined pink *Coccus*) Van Zwaluwenburg 14–34; 15–42; 17–515: on *Inga laurina* and coffee.
Wolcott 23–58: in tunnels of "hormiguilla" in *Inga vera* and *Inga laurina.*
in twigs of *Inga laurina* at Lares (6–22 TYPE); of *Ficus laevigata* at Manatí (362–23 det. Ferris).

Ceroplastes ceriferus Anderson
on *Bursera simaruba* at Guánica (234–11 det. Sasscer, 334–13); on *Sauvagesia erecta* at Naguabo (58–14).

Ceroplastes cirripediformis Comstock
on *Myrcia panniculata* at Algarrobo (792–14 det. Rust).

Ceroplastes cistudiformis Townsend and Cockerell
Van Z. (1631): on *Euphorbia robusta* and *Ipomoea fastigiata.*

Ceroplastes floridensis Comstock
Busck 00–92: on *Anona reticulata.*
Barrett 03–445: on citrus.
Tower 08–38: on rose and orange.
Van Z. (16): on orange, *Psidium guajava, Ipomoea* sp., *Mangifera indica* and *Anona reticulata.*
on *Rapanea guianensis* (59–15 det. Rust), on grapefruit (118–15, 164–15), on *Persea gratissima* (50–18); on *Ficus laevigata* at Yabucoa (139A–16); on *Laguncularia racemosa* at Fajardo (162–23 det. Morrison).

Vinsonia stellifera Westwood
Busck 00–92: on *Cocos nucifera* at Cataño, Arroyo and Bayamón.
(as sp.) Barrett 03–446, 447: on rose apple (*Jambos jambos*) and coconut.
Van Z. (1214): on *Mangifera indica,* manila hemp, *Musa* sp., *Eugenia jambos,* coconut, *Agave sisalana* and *Psidium guajava* at Mayagüez.
on *Coccoloba laurifolia* (11–14 det. Van Dine), on *Eugenia jambos* (437–12), on undetermined plant (236–13), on *Lawsonia inermis* (265–16); on *Cocos nucifera* at Santurce (214–11); on *Eugenia jambos* at Mameyes (831–12); on *Mangifera indica* at Santa Isabel (397–13); on orchid leaves at Martin Peña (222–16); on *Achras sapota* at Vieques Island (422–19).

Inglisia vitrae Cockerell
Jones 17–7: on *Cajanus indicus* at Mameyes and Comerío.
on *Bixa orellana* (35–14); on *Inga vera* at Guayama (380–21 det. Morrison).

Coccus hesperidum Linnaeus
on *Agave sisalana* (2–15 det. Rust); on *Agave sisalana* at Trujillo Alto (92–16)

Coccus mangiferae Green
Van Z. (1215): on *Solanum* sp., *Cinnamonum zeylanicum, Mangifera indica* and *Artocarpus communis.*
Johnston 15–19: host of *Cephalosporium lecanii* at Río Piedras
Stevenson 18–207: host of *Botrytis rileyi* at Río Piedras.
on *Eugenia jambos* (437–12), on *Blighia sapida* (223–16); on *Nectandria* sp., at Plantaje (27–16).

Saissetia hemisphaerica Targioni
(as *Lecanium*) Busck 00–92: on eggplant at Cataño, on coffee at Caguas.
(as *Lecanium*) Barrett 03–444, 445, 446, 447: on coffee, *Anona muricata,* cassava; probably the most common scale on orange.
(as *Lecanium*) Earle 03–458, 459, 463: on orange and at times abundant and destructive to coffee.
Tower 07–26; 08–32; 08–23; 11–15: injurious to citrus trees.

Jones 15-4: on eggplant. Illustration, pl. 1, fig. 1.
Johnston 15-19: host of *Cephalosporium lecanii* at Río Piedras.
(as *Lecanium* sp.) Wetmore 16-66, 106, 116, 119, 121: eaten by P. R. Tody, Parula Warbler, Oriole, Mozambique and Tanager.
Cotton 18-301: on eggplant. Illustration.
Stevenson 18-208: host of *Cephalosporium lecanii* at Río Piedras, Espinosa, Bayamón, Vega Baja, Comerío, Sabana Llana.
Smyth 19a-126: on *Murraya exotica*.
Van Z. (9): on orange, *Coffea arabica*, *Anona reticulata*, *Antigonum leptopus*, *Solanum seaforthianum* and *Drypetes glauca* at Mayagüez.

on *Schinus molle* (425-12), on *Gardenia jasminoides* (291-12, 485-12, 41-19, 45-19); on *Eugenia jambos* (437-12), on *Graptophyllum pictum* (586-12, 270-16); on *Solanum melongena* (925A-13, 547-16); on *Psychotria* (74-15), on *Palicourea* sp. (76-15), on undetermined plant (77-15), on grapefruit (119-15), on *Myrcia deflexa* (78-15), on *Momordica charantia* (151-16), on *Lawsonia inermis* (265-16), on *Lagerstroemia indica* (267-16), on coffee (271-16), on *Persea gratissima* (761-19), on undetermined plants (550-12, 234-13); on *Schinus molle* at Guánica (229-11); on *Psidium guajava* at Luquillo (476-12); on *Sida* sp. at Luquillo (474-12); on *Solanum nigrum* var. *americanum* at Luquillo (473-12); on *Zamia integrifolia* at Vega Alta (544-12); on coffee (833-12), on *Thunbergia erecta* (830-12) at Mameyes; on *Rauwolfia tetraphylla* at Ponce (132-13); on *Leptilon canadense* (789-13), on orchid and coffee (50-21) at Ciales; on balsam at Arecibo (11-15); on *Achyranthes indica* on Carolina road, (57-15); on *Phoradendron antillarum* at Juana Díaz (71-15); on fern at Bayamón (142-15); on *Zamia integrifolia* (116-16), and mamey seedling (117-16) at Vega Baja; on cycad and *Gardenia jasminoides* at San Juan (447-19); on coffee, at Lares (165-20), at Adjuntas (92-22) and at Maricao (171-22).

Saissetia nigra Nietner
(as *Lecanium nigrum* var. *depressum* Targ.) Busck 00-92: on *Terminalia catappa* at San Juan; on cotton at San Juan.
Fernald 03-204, 205: from Porto Rico.
Hooker (1653): on *Hura crepitans* and *Euphorbia sanguinea* at Mayagüez.

on *Schinus molle* (287-12), on *Melia azedarach* (554-16), on *Coleus verschaffeltii* (275-16), on *Ionoxalis intermedia* (4-17), on *Terminalia catappa* (93-22); on *Pavonia typhalaea* at Canóvanas (246-13); on *Gossypium barbadense* at Guánica (480-13); on *Melia azedarach* at Fortuna (396-13); on *Solanum nigrum* var. *americanum* (473-12), on *Sida* sp. (474-12), and on *Melia azedarach* (788-12) at Luquillo; on *Thespesia grandiflora* at Manatí-Ciales (55-15).

Saissetia oleae Bernard
(as *Lecanium*) Busck 00–92: on *Calabassa* tree at Lares, on honey-locust at Adjuntas, on *Guazuma ulmifolia* at Guayama, on *Terminalia catappa* at Mayagüez.
Van Z. (13): on *Erythrina micropteryx*, oleander, orange, *Guazuma ulmifolia*, *Terminalia catappa* and *Solanum torvum* at Mayagüez.
on *Erythrina glauca* (230–13), on *Sicana odorifera* (207–17); on *Terminalia catappa* at Guánica (228–12).

Aclerda tokionis Cockerell
Smyth 19–150: on sugar cane.
Wolcott 2:24: 0.1% of sugar cane infected in transmission of mosaic disease by Smyth.
on sugar cane (1–15 det. Sasscer, 103–18), at Humacao (144A–16), at Guánica (585–14, 645–14).

DIASPINAE.

Chionaspis citri Comstock
Busck 00–93: on lime at Añasco.
Barrett 03–445: on mango and lime.
Tower 09–24, 25: on orange.
Van Z. (7): on orange at Manatí and Garrochales; *Pilea* sp., *Citrus decumana*, and grapefruit at Garrochales.
Jones 17–9: "this species is one of the most injurious scale pests of the citrus groves of Porto Rico."
Stevenson 18–134, 185, 219: host of *Myriangium duriaei* at Sabana Llana, Río Piedras, Pueblo Viejo, Bayamón, Santurce, Espinosa, Vega Baja and Garrochales; host of *Septobasidium spongia* at Río Piedras, Espinosa, Pueblo Viejo, Campo Alegre, Garrochales, Vega Baja and Bayamón; host of *Tubercularia coccicola* at Espinosa, Río Piedras, Pueblo Viejo and Bayamón.
on orange (101–19), at Mameyes (839–12); on wild orange at Yabucoa (141A–16), at Old Loíza (254–16).

Chionaspis sp. near **spartinae** — det. Morrison
on *Sporoholus bertoreanus* at Arecibo playa (163–23).

Howardia biclavis Comstock
Busck 00–93: on *Bixa orellana* at San Sebastián and Añasco.
Hooker: on coffee (625), on *Achras sapota* (1251), *Mammea americana* (1252), on *Doryalis caffra* (1649) at Mayagüez.
Van Z. (1230): on *Bixa orellana, Achras sapota*, and *Plumiera rubra*.
Stevenson 18–134: host of *Myrangium duriaei* at Río Piedras.
on *Bixa orellana* (263–12), on *Hymenaea courbaril* (37–14), on *Casearia arborea* (232–13), on *Cajanus indicus* (982–13), on *Guettarda scabra* (233–13); on *Chrysophyllum cainito* (829–12), and on *Mammea americana* (835–12) at Mameyes; on *Guettarda scabra* (738–13), and *Cordia* sp. (737–13) at

Dorado; on *Tecoma pentaphylla* (59–14), and *Acalypa wilkesiana* (56–14) at Naguabo; on *Cassia fistula* at Aguirre (75–16); on *Castalloa elastica* at Bayamón (415–16); on *Waltheria americana* at Martin Peña (277–16).

Diaspis echinocacti Bouché

(as *Diaspis calyptroides* Costa, var. *opuntiae* Ckll.) Busck 00–93: at Ponce.

Fernald 03–229, 230: from Porto Rico. The following are given as food plants in the various countries where it occurs: *Opuntia ficus-indica, Echinocactus ottonis* and *E. tenuispinus.*

Aulacaspis pentagona Targioni

Busck 00–93: on castor-oil plant at Río Piedras, on unknown tree at Bayamón, on peach at Adjuntas, on honey-locust, on "mahagua" at Fajardo.

Earle 03–458, 467: "very commonly on orange, as well as on various other trees and plants - - - killing a great many of the (pawpaw) trees."

Barrett 03–446: very destructive to peach trees in the east part of the Island; also attacks mulberry and pawpaw.

Tower 07–27: very abundant all over the Island, infesting peach, plum, mulberry, pawpaw, castor bean and other plants.

Jones 15–4: on okra and pepper.

Johnston 15–28: host of *Myriangium duriaei* at Pueblo Viejo, Santurce, and Río Piedras.

Jones 17–9: the papaya suffers especially from its attacks.

Cotton 18–303: on okra.

Stevenson 18–134: host of *Myriangium duriaei* at Río Piedras and Sabana Llana.

Hooker (1651): on *Salix humboldtiana* at Mayagüez.

Van Z. (1248): on *Carica papaya, Hyptis* sp., *Erythrina micropteryx, Nerium oleander, Capsicum* sp., orange; on *Mangifera indica* at Mayagüez; on *Paritium tiliaceum* at Mameyes and Adjuntas; on *Manihot utilissima* at Añasco.

on "malva" (290–12), on *Carica papaya* (684–12), on *Cajanus indicus* (409–13), on *Hibiscus esculentus* (923A–13), on garden pepper (924A–13), on *Trema micrantha* (982–14), on *Carica papaya* (11–16), on cotton (12–16), on *Acalypha wilkesiana* (471–16), on *Solanum torvum* (439–17), on *Ricinus communis* (776–19), on *Hibiscus sabdarifa* (354–21); on *Salix* sp. at Ponce (165–12); on *Urena lobata* at Dorado (739–13), and at Bayamón (140–15); on *Bryophyllum pinnatum* at Comerío (774–13); on *Mammea americana* at Naguabo (54–14); on *Hyptis* sp. at Maricao (791–14); on *Trema micrantha* at Juana Díaz (83–15); on *Maga grandiflora* at Espinosa (84–15); on *Ricinus communis* at Hormigueros and Guánica (85–15), at Ciales (788–13); on *Carica papaya* at Guánica (255–15, 261–15).

Hemichionaspis aspidistrae Signoret
on leaves of fern, *Nephrolepsis exaltata* var. ***bostoniensis*** (104–16 det. Sasscer).

Hemichionaspis buxi Bouché
on *Areca lutescens* (20–14), on *Acrocomia media* **(22–14)**, on *Areca* sp. (116–15); on leaves of a tree epiphyte belonging to the family *Bromeliaceae* at Mameyes (832–12); on *Philodendron* sp. at Ciales (787–13); on ornamental palm at Trujillo Alto (128–22 det. Morrison); on cotton at Maunabo (5–22 det. Ferris).

Hemichionaspis minor Maskell
Busck 00–93: on eggplant at Cataño; on *Guazuma ulmifolia* at Guayama.
Jones 15–4: on eggplant.
Jones 17–10: "a common species sometimes found in company with *Saissetia nigra* (Nietn.), and *S. hemisphaerica* (Targ.) ... on *Pithecolobium saman* at Mayagüez.
Cotton 18–101: attacks stems and branches of eggplant.
Stevenson 18–134: host of *Myrangium duriaei* at Palo Seco.
Van Z. (1402): on eggplant, *Guazuma ulmifolia*, cotton and *Asparagus sprengeri*.
on eggplant (925A–13), on *Valerianodes jamaicensis* (334–12, 72–15); on *Gomphrena globosa* (121–15), on *Capsicum* sp. (122–16), on undetermined plant (550–12), on mulberry (527–23); on *Gossypium barbadense* at Guánica (210–13), (480–13); on *Aeschynomene sensitiva* at Naguabo (55–14); on *Melia azedarach* at Fortuna (near Ponce) (396–13); on ornamental croton (*Codiaeum* sp.) at Naguabo (92–11); on *Solanum torvum* (475–12), on *Triumfetta semitriloba* (477–12), on *Anona reticulata* (35–15) and *Melia azedarach* (788–12) at Luquillo; on *Lantana involucrata* at Mameyes (827–12); on *Asparagus sprengeri* at Mayagüez (754–14); on *Sesbania grandiflora* at Garrochales (197–16); on *Cajanus indicus* at Old Loíza (256–16); on unknown liana at Plantaje (46–16).

Leucaspis indica Marlatt, C. L., *in* Bur. Ent. (Tech. Ser.) Bul. **16, pt.** II, pp. 26–27, pl. VII, fig. 2: "On mangoes imported from India, at Miami, Fla. and from Mayagüez, Porto Rico," **TYPE** from Porto Rico.
Jones 17–11: collected on mango (*Mangifera indica*) at Mayagüez.

Aspidiotus (Aonidiella) cocotiphagus Marlatt—det. Morrison.
on coconut palm fronds from Pt. Cangrejos (GNW); on *Jasminium sambac* at Monte Flores (301–23).

Aspidiotus cyanophylii Signoret
Van Z. (1606): on ***Aleurites cordata***, banana, ***Clusia rosea, Eugenia malaccensis, Dillenia indica, Vitex divaricata, Nerium***

oleander, Eriobotryra japonica, Pischofia sp., *Washingtonia robusta, Eucalyptus* sp., *Barringtonia* sp., *Viola* sp., *Monstera deliciosa, Albizzia stipulata, Piper* sp., *Mangifera indica*, and *Citrus decumana.*

on *Eucalyptus* at Naguabo (52–14).

Aspidiotus destructor Signoret

Cockerell, T. D. A., 95–261: Can. Ent., XXVII.

Busck 00–93: on banana leaves at Cataño, San Juan and Arroyo.

Barrett 03–447: at Ponce many of the coconut trees were dead or dying from attacks of this coccid.

Van Z. (1229): on *Cocos nucifera, Phoenix dactylifera* and *Musa* sp.

Stevenson 18–207: host of *Botrytis rileyi* at Punta Cangrejos.

on *Grevillea robusta* (288–12), on *Psidium guajava* (286–12), on *Cocos nucifera* (352–12), on *Musa paradisiaca* var. (686–12), on *Persea gratissima* (18–16), on screw palm, *Pandanus* sp., (117–15), on Euphorbiaceous plant (86–16), on *Cocos nucifera* (134–16), on *Psidium guajava* (2–17), on *Terminalia catappa* (93–22 det. Ferris); on *Cocos nucifera* at Santurce (31–11); on *Persea gratissima* at Mameyes and Guayama (82–13); on *Anona palustris* at Algarrobo (793–14); on *Mammea americana* (25–16), and *Cocos nucifera* (26–16) at Plantaje; on pomgranate at Aguirre and Guánica (193-16); on undetermined plant at Barceloneta (221–16).

Aspidiotus forbesi Johnson

Fernald 03–259, 269: occurs in Porto Rico.

Jones 17–12: "with the possible exception of 'Jazmines' no tropical plants are included in the list.

Aspidiotus lataniae Signoret

Hooker (1635): on *Castilla* sp. at Mayagüez.

on *Jasminium sambac* at Monte Flores (301–23 det. Morrison).

Aspidiotus sacchari Cockerell

Van Dine 11–19, 31; 12–22; 13–34; 13–251, 257: on sugar cane.

Hood, J. D., *in* Insecutor Inscitiae Menstruus, Vol. I, No. 6, pp. 65–70, June, 1913: taken with *Odonaspis* sp. on stalks of "malojillo" (*Panicum barbinode*) at Guánica.

Jones 17–12: on sugar cane at Canóvanas.

Smyth 19–150: on sugar cane.

Wolcott 21–35: on sugar cane.

on sugar cane (98–12 det. Van Dine); on sugar cane at Guánica (14–10), at Fortuna (53–10), at Fajardo (21–11), (81–11), at Humacao (99–12).

Pseudaoni articulatus Morgan

Busck ‑13: on orange leaves at El Yunque, February 18; about 2,000 feet altitude.

Barrett 03–445: on citrus.
Tower 08–38; Tower 09–25: on orange.
Van Z. (15): on orange.
Jones 17–12: on *Anona muricata* at Río Piedras.
Stevenson 18–219: host of *Microcera fujikuroi* at Pueblo Viejo.
on *Eugenia jambos* (437–12), on wild orange (16–16), on *Eucalyptus* sp. (52–14) at Naguabo; on *Ficus nitida* at San Juan (58–15); on grapefruit at Trujillo Alto (36–15); on wild orange on Carolina road (48–15); on *Chrysophyllum* sp. at Garrochales (13–16).

Pseudaonidia tesserata de Charmoy
on garden rose (441–17 det. Cotton); at Mameyes (838–12 det. Sasscer) on rose; on *Inga laurina* at Lares (6–22 det. Ferris).

Chrysomphalus aonidum Linnaeus
Busck 00–93: on *Terminalia catappa* at San Juan; on *Anona muricata* at San Juan; on oleander at Ponce; on *Musa* at Caguas.
(as *Aspidiotus ficus*) Earle 03–459; Barrett 03–445:
(as *Chrysomphalus ficus*) Tower 07–25, 26; 08–32; 09–24: on orange.
Tower 11–14, 15: on orange and lemon.
Carnes, E. K., *in* Bull. State Comm. Hort., Vol. I, No. 8, 1912, Sacramento, California, on p. 398: received from Porto Rico.
Johnston 15–29: host of *Sphaerostilbe coccophila* at Bayamón.
Stevenson 18–219: host of *Microcera fujikuroi* at Pueblo Viejo.
Van Z. (8): on orange, lemon, "pomelo", rose, *Agave sisalana, Cocos nucifera,* oleander, *Anona muricata, Musa* sp. and *Terminalia catappa.*
on *Ficus nitida* at San Juan (58–15); on grapefruit at Carolina (115–15); on *Gemmingia chinensis* at Bayamón (147–15); on leaves of *Cocos nucifera* at Guánica (171–16); on wild orange at Ponce (52–22).

Chrysomphalus aurantii Maskell
Busck 00–93: on *Anona muricata* at San Juan; on *Anona muricata* at Ponce.
Barrett 03–445: reported it as an enemy of citrus stock, with note, "rare but apparently spreading."
Van Z. (14): on orange and rose.
Smyth 19a–125: on *Murraya exotica.*

Chrysomphalus dictyospermi Morgan
on *Mangifera indica* (530–12), on *Cocos nucifera* (864–14); on *Cycas revoluta* at Naguabo (53–14, 333–17).

Chrysomphalus personatus Comstock
(as *Aspidiotus*) Busck 00–93: on plantain leaves at Caguas; on *Anona muricata* at San Juan; on banana leaves at Cataño; on coconut palm at Mayagüez.
Van Z. (1228): on coconut palm, mango, *Bertholonia excelsa*, *Inga laurina*, *Musa* sp. and *Anona muricata*.
Jones 17–13: on *Mangifera indica* at Santa Isabel; on *Ficus* sp. at Mameyes.
on *Ficus* sp. (19–22, 549–12); on *Eugenia jambos* (237–13), on *Laguncularia racemosa* (13–14), on *Banisteria laurifolia* (859–14), on *Calophyllum calaba* (148–15), on *Anona* sp. (598–16); on *Cocos nucifera* at Santurce (213–11); on *Mammea americana* at Mameyes (836–12); on *Ficus nitida* at San Juan (58–15); on *Eucalyptus* sp. at Naguabo (52–14); on *Mammea americana* at Plantaje (25–16); on *Jasminum sambac* at Fajardo (143A–16); on undetermined plant at Canóvanas (192–16); on *Mammea americana* at Cupey Alto (417–16); on *Symplocos latifolia* at Bayamón (418–16); on *Cocos nucifera* at Point Cangrejos (119–21 det. Morrison).

Pseudischnaspis bowreyi Cockerell
Hooker (1652): on asparagus at Mayagüez.
Van Z. (1256): on rose and *Persea gratissima*.
on *Agave sisalana* (520–17 det. Dietz).

Targionia biformis Cockerell
Hooker (1236): on *Bromelia pinguin* at Mayagüez.
Van Z. (1647): on *Agave sisalana* at Mayagüez.
Jones 17–13: on *Agave sisalana, Persea gratissima* and *Mangifera indica* at Río Piedras; on *Cycas revoluta* at Naguabo.
on *Bromelia pinguin* at Mameyes (824–12), at Naguabo (142A–16), at Canóvanas (195–16); on *Agave sisalana* on Trujillo Alto road (93–16), at Salinas (77–16), at Cabo Rojo (3–16) and at Cayey (GNW); on *Pedilanthus tithymaloides* at Fortuna (164–16); at Guánica (130–23).

Pseudoparlatoria ostreata Cockerell
Van Z.: on *Solanum seaforthianum* and *Acalypha* sp. at Mayagüez.

Lepidosaphes beckii Newman
(as *Mytilaspis citricola*) Earle 03–457, 458; Barrett 03–445:
Tower 07–26; 08–32, 33; 09–23, 24; 10–24, 25: on orange and citrus. Tower 11–13, 15: on citrus.
Carnes 12–398: from Porto Rico.
Van Z. (6): on orange and lemon.
Johnston 15–13: host of *Aschersonia turbinata* at Río Piedras.
Johnston 15–29: host of *Scoleconectria coccicola* at Pueblo Viejo, and Río Piedras.
Johnston 15–29: host of *Sphaerostilbe coccophila* at Río Piedras.
Jones 17–14: "this species has been more often mentioned as

a pest of citrus orchards than any other scale insect - - - the species was taken on ornamental croton (*Codiaeum* sp.) at Río Piedras by the writer."

Cotton, R. T., "Scale-Feeding Habits of a Porto Rican Millipede, *Rhinocritus arboreus* Saussure." Jour. Dept. Agr. P. R., Vol. I, No. 3, July, 1917, pp. 175–176: " - - - about a dozen (of these millepedes) placed on several small grapefruit trees that were heavily infested with purple scale. - - - At the end of two weeks the trees were perfectly clean and free from scales and the bark took on a fresh green color."

Stevenson 18–185: host of *Septobasidium spongia* at Río Piedras, Espinosa, Pueblo Viejo, Campo Alegre, Garrochales, Vega Baja and Bayamón.

Stevenson 18–134: host of *Myrangium duriaei* at Sabana Llana, Río Piedras, Pueblo Viejo, Bayamón, Santurce, Espinosa, Vega Baja, Garrochales.

Stevenson 18–150: host of *Scoleconectria coccicola* at Río Piedras, Pueblo Viejo, Bayamón, Espinosa, Garrochales and Mayagüez.

Stevenson 18–150: host of *Sphaerostilbe coccophila* at Río Piedras, Pueblo Viejo, Bayamón, Vega Baja, Manatí, Espinosa, Garrochales, and Mayagüez.

Stevenson 18–219: host of *Microcera fujikuroi* at Bayamón, Mayagüez and Pueblo Viejo.

Stevenson 18–219: host of *Tubercularia coccicola* at Espinosa, Río Piedras, Pueblo Viejo, Bayamón.

Smyth 19a–126: on *Murraya exotica.*

on *Murraya exotica* (19–18); on wild orange at Old Loíza (254–16).

Lepidosaphes lasianthi Green

on *Croton humilis* (548–12 det. Sasscer).

Ischnaspis longirostris Signoret

Busck 00–93: on coconut palm at Caguas, Cataño, Mayagüez, and Arroyo.

Hooker (1654): on *Ficus repens* at Mayagüez.

Van Z. (1604): on *Roystonea borinquena, Washingtonia robusta,* coffee, *Pterocarpus draco, Bignonia unguis-cati,* at Mayagüez.

on *Ixora ferrea* (756–14), on *Acrocomia media* (757–14), on *Dalbergia monetaria* (79–15), on *Anona* sp. (598–16); on *Citharexylum fructicosum* at Naguabo (911–14); on *Asparagus sprengeri* at Mayagüez (754–14); on *Jasminum sambac* at Santurce (69–21), on *Cocos nucifera* (on outside husk of fruit) at Mayagüez (144–21, 436–21); on ornamental palm at Trujillo Alto (128–22 det. Morrison).

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INDEX OF ORDERS, FAMILIES AND GENERA OF INSECTS, AND THE SPANISH COMMON NAMES OF INSECTS.

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"INSECTAE PORTORICENSIS"

CORRECTIONS AND ADDITIONS.

p. 2. for "January, 1924," read "Actual Date of Publication, March 5, 1924."

p. 64. for "*Anagrus,*" read "*Anagris,*" and for *Tetragonochlora,* read *Tetragonochora.*

p. 69. for "*Uteles,*" read "*Uletes.*"

p. 142. remove parenthesis from *Ageronia ferentina* Godart, and omit the last sentence. Add "two adults collected by F. Sein on trunks of *Inga laurina* in old coffee grove near Aibonito, January 29, 1924."

p. 160. under *Chloridea virescens* Fabr., add "eating green gandulis out of pods at Loíza, reared by F. Sein (5-24)."

p. 273. after *Neomalaxa flava* Muir, instead of "— det. Muir," add, ",F, *in* Proc. Hawaiian Ent. Soc., Vol. 3, No. 5 (1918) p. 426, TYPE from Mayagüez, Porto Rico."

after *Nilaparvata wolcotti* Muir, instead of "MS." add, ",F. & Giffard, W. M., *in* 'Studies in North American Delphacidae' Bull. 15 (Entomological Series) Expt. Sta. Hawaiian S. P. A., January 16, 1924, p. 17."

p. 280. under *Asterolecanium pustulans* Cockerell, add "on petioles of leaves and on trunk of young apple tree at Bayamón (7-24)."

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EXPERIENCES IN THE MANUFACTURE OF CANE SUGAR IN PORTO RICO

BY

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[1] As of date of issue, November 1923.

EXPERIENCES IN THE MANUFACTURE OF CANE SUGAR IN PORTO RICO.[1]

By R. MENÉNDEZ RAMOS, M. S.

INTRODUCTION.

The object of this paper is to collect in a permanent form some of the data the author was able to obtain during seven years of continuous work as Chemist and Superintendent in a small, but modern, cane-sugar factory in Porto Rico. It is not the intention of the writer to teach anything fundamentally new to his fellow workers in the industry; but merely to recall hereby the problems which he had to deal with and to discuss some of the facts he found of importance in the routine of his daily work. The fact that seven consecutive years were spent in the same sugar house gave us ample opportunity to compare our observations, to correct the inevitable errors and to check the results obtained during different crops under similar conditions. This is especially true of the four consecutive seasons for 1917–18, 1918–19, 1919–20, and 1920–21. During the first two years, 1915–16, 1916–17, the factory equipment was incomplete and no attempt was made to exhaust the final molasses below 30 purity. The last season, 1921–22, was also abnormal in that the grinding was not continuous; the factory running only 12 to 18 hours a day, on account of lack of cane, and of course no comparative results can be expected from a work of this nature.

There is no claim for anything of supreme importance in this work. The discussion of our past troubles might help somebody else to get by the same or similar difficulties in the future; then our aim would be fulfilled. When we read a travel book telling of the experiences of some other party while going over places which to us are familiar, the acquaintance with the subject-matter makes the reading of interest; it is in a similar way that the attention

[1] Paper presented at the third biennial meeting of the "Association of Sugar Technologists of Porto Rico," June 17, 1923.

of our fellow sugar technologists might be held by this work. Possibly there may be in it something more than the mere sugar-house chronicle; but that, of course, remains to be seen.

The discussion will take place in two parts; one, the first, dealing with the exhaustion of final molasses; and the other, with the method of centrifuging low grade massecuites called by the writer "differential curing of final sugars."

I.

KEEPING DOWN THE PURITY OF FINAL MOLASSES.

THE TASK OF THE SUGAR CHEMIST.

The more perfect exhaustion of the final molasses resulting from the process of manufacturing is, to be sure, the task to be accomplished by every superintendent of fabrication in a sugar house. Naturally, the keeping down of the purity of the final molasses has its limitations. Sometimes the managers and owners of sugar mills give too much importance to the fact that their final molasses are well exhausted, say to a purity of 28, for example; but at times it is true that they have not taken the trouble to inquire if it would have been a better bargain for them to obtain only a final purity of 30 or more. We know perfectly well that it all depends on several factors, to wit: the price of sugar, the capacity of the boiling house in relation to the milling plant, the equipment of crystallizers, centrifugals, etc. But there is no desire to go into details. We only want to state the fact, so that no one need think that we attach supreme importance to the mere circumstance that the final goods be well exhausted, without considering if to get such low purities the economic side of the manufacture was ignored.

We are fully convinced that the best superintendent of fabrication is the one who adapts and combines his technic to the environment and the business in such a way, that he gets, out of a given amount of cane ground, the greatest possible amount of sugar at the lowest possible cost. This made clear, it would be well to add, also, that in order for him to attain high proficiency in his art the sugar chemist must give eternal vigilance to all the multiple details of the process of manufacture.

This is especially true in regard to his work with the final goods. Am I keeping down the purity of the final molasses without any extraordinary expense? Are the molasses for the present week being exhausted as well as those of the previous run? Is there proper uniformity in the work at the crystallizers? Are the final massecuites curing well? Is there any minor detail of the process that could be improved? Would the improvement be worth while?

These and similar questions were always in my mind while at my daily work as Superintendent of Fabrication in a modern sugar factory in Porto Rico.

BOILING HOUSE CAPACITY AND ITS RELATION TO FINAL MOLASSES.

Every experienced sugar chemist is familiar with the fact that the larger the excess capacity of the grinding plant over the capacity of the boiling house, the higher the purity of the final molasses. This seems to indicate that in order to obtain the optimum exhaustion of the final molasses the work should be performed without rush. If the mill produces more juice each 24 hours than the amount the factory can dispose of with ease, it is inevitable that the work is rushed, and the hastening of the elaboration process, caused by the unavoidable "full houses," is bound to result in final products of high purity. If the cane that is ground is of low purity, it is natural to expect that the sugar chemist will have a more difficult task to accomplish.

We have had the opportunity to work, during the last seven years, in a sugar factory whose milling capacity was superior to its centrifugal capacity; and where, moreover, the cane ground was of low purity, because of various reasons outside of the control of the management. The work was to be accomplished, therefore, under difficulties in respect to the final molasses. The centrifugal capacity was scarcely enough to carry on through and in many occasions there was before us the eternal dilemma of either permitting higher purities in the final molasses (over 30 purity) or cutting down the grinding of the mill. Both solutions of the problem are always disliked by every superintendent of fabrication who strives to keep up the quality of his work. It was, hence, our aim to look for some way to facilitate the curing of the final massecuites, in such a manner that the elimination of the impurities be made without sacrificing either the grinding capacity or the house recovery.

To this effect the author's attention was concentrated on the crystallizer department and on the outfit of centrifugals for final sugars.

One of the difficulties that called our attention was the fact that some low-grade strikes were taking too much time for curing; so much so that sometimes we found ourselves working under great difficulties in the factory and in fact at our wits end, in order to make way for other final massecuites which had of necessity to be dumped into one of the crystallizers.

PROCESS OF MANUFACTURE.

In order that the situation be better understood it may be convenient to outline here part of the process of fabrication such as it was carried on at the Central. The three-strike method was used. First strikes were always boiled from syrup, without any addition of first molasses or "topping off." Naturally the purity of such massecuites varied according to the purity of the syrup, both having always about the same coefficient of purity. Such first strikes were usually about 82 purity and gave first molasses of about 60 purity. This molasses was reboiled on seed from syrup, to make second massecuite of about 70 purity, whose resulting second molasses had purities fluctuating around 46. With these molasses, reboiled over a seed of syrup, the final massecuites were concentrated to a Brix of 96°+, and the purities were worked down to about 56. Good care was also taken to see that the temperature was kept around 150°F. with a vacuum of 27 inches.

The first and second massecuites were always cured hot; the final strikes were dumped into air-cooled crystallizers, where they were cooled in motion for four or five days previous to curing.

It is important to state that final goods were worked into magma; that is, the final strikes were only partially dried—the charge was dropped wet from the baskets—and the resulting sugar was mixed in a special small mixer placed at one end, just below the sugar conveyor,[1] with undiluted second molasses of 87°–88° Brix. The magma thus prepared was pumped to a small crystallizer situated just over the mixer corresponding to the centrifugals for first and second sugars. From here the magma was intermittently discharged, as the occassion warranted, into the centrifugal mixer and was usually dried together with the hot second massecuites or alone. Magma was never cured together with first sugars.

The molasses yielded by the magma, with a purity around 40, was considered and handled as second molasses. The polarization of the sugar from magma was always below 96, varying usually from 92 to 95; but as the commercial sugars are always mixed with one another and the first and second strike comprise the greater bulk of the total production, the final result was 96°+ test sugar uniformly.

[1] Screw conveyor.

ACCUMULATION OF IMPURITIES IN THE SUGAR HOUSE.

It is evident that molasses from magma sugar contain a large part of the impurities which would be eliminated with the final molasses if the low grade sugars were dried to the bag or until dry enough to be mixed with first and second sugars. These impurities circulate, naturally, from the pans to the crystallizers and back with the magma molasses, in such a fashion that they tend to increase enough to hinder the process of manufacture. The freeing of the house from such impurities is then unavoidable, and it is necessary to dry all the crystallizers to the bag and hence to stop temporarily the making of magma. Such drying to the bag of a set of crystallizers meant, in our case, a weekly run with final molasses at 34 or 35 purity, a condition which was very unwillingly run into by us.

The antiquated method by which final sugars are dried enough to be directly mixed with the higher polarizing sugars, never appealed to us all because in that way it is difficult to get the final molasses to low purities. The making of magma and double curing of final sugar,[1] even though it is more troublesome and even though it makes the process of manufacture somewhat more complicated, is undoubtedly the one way to keep down the coefficient of purity of the final molasses below 30.

The question to be solved is, then, to maintain a permanent equilibrium between the impurities coming into the house with the juices on the one hand, and the impurities to be eliminated from the factory in the form of final molasses on the other, keeping these always at the lowest possible coefficient of purity.

FACTORS AFFECTING THE VISCOSITY OF THE FINAL MASSECUITES.

Now then; the viscosity of the final massecuites, or better said, the viscosity of the molasses contained therein, is known to depend on various factors, to wit:

(*a*) Concentration of the massecuite.

(*b*) The amount and nature of the impurities.

(*c*) The presence of insoluble material in the form of very minute grains.

(*d*) Temperature.

The concentration and temperature can be easily controlled.

[1] Magma may, of course, be made with syrup instead of second molasses and be then used for seed grain for first and second strikes.

Every superintendent of fabrication knows well that a third massecuite which has been rightly boiled, with a concentration of 96° Brix, and coefficient of purity from 56 to 57, should cure well after cooling, without any difficulty arising from excess viscosity. Dr. Prinsen Geerligs states[1] that cooling beyond 45° C. is detrimental, because at this temperature crystallization has come to an end; he further explains that at lower temperatures the viscosity of the final goods increases to such an extent that it only causes difficulties without offering any advange in compensation.

During our experience we have been unable to ascertain that a massecuite cooled in the crystallizer to a temperature of 30°C. is considerably more difficult to cure than one cooled to 40° C., provided the strikes were otherwise identical; but it was found that final sugars which stayed in the crystallizers more than the usual time allowed for cooling. and which were cooled in motion to the temperature of the air around them (28°–30° C), have cured with practically equal ease as the others, which were not at quite such low temperature. This was the case during the first weeks of grinding and after the usual stops of New Year and Easter Week festivities. It should be noticed that exceptionally low coefficients of purity were then obtained in our final molasses, a fact which should surely compensate some extra labor involved in the centrifuging of those sugars.

Here again, the price of sugar is a factor to be taken into consideration; as it always will be a determining factor in narrowing or broadening, so far as final molasses is concerned, the margin of diminishing returns.

The following tables of crystallizers sugar and their corresponding final molasses may be of interest:

Milling Season 1917–1918.

Massecuite			Date of boiling	Date of curing	Time of cooling. Days	Purity of final molasses
Brix.	Suc.	Pur.				
95.6. ...	53.4	55.85	Dec. 22	Jan. 10	18	25.33
96.6. ...	51.0	52.79	Dec. 23	Jan. 12	19	26.36
95.4. ...	52.4	54.93	Mar. 27	April 5	9	27.05
96.0.....	52.4	54.58	Mar. 28	April 6	9	26.81
96.4.....	52.8	54.80	June 13	June 22	9	27.30
96.4.....	52.4	54.36	June 14	June 25	11	28.10
96.8.....	55.6	57.44	June 14	June 27	13	28.10

[1] "Cane Sugar and its Manufacture," by H. C. Prinsen Geerligs.

Average time in the crystallizers for the crop ---------- 6 days.
Massecuites:
Average Brix ---------- 96.30
Average purity ---------- 57.00
Final molasses:
Average purity ---------- 30.00
Gallons per ton of cane ---------- 5.5

The slow and complete cooling undoubtedly contributed to the thorough exhaustion of the final molasses, the history of which has been set out in the table above.

Milling Season 1918–1919.

Massecuite			Date of boiling	Date of curing	Time of cooling. Days	Purity of final molasses
Brix.	Suc.	Pur.				
97.8.....	56.0	57.26	Feb. 1	Feb. 9	8	26.26
96.8.....	55.2	57.02	Feb. 1	Feb. 10	9	27.45
95.4.....	54.0	56.70	Feb. 2	Feb. 12	10	27.94
96.2.....	54.0	56.13	April 13	April 22	9	29.70
96.6.....	50.8	52.59	April 13	April 23	10	29.43
96.8.....	54.8	56.61	April 14	April 23	9	28.70
95.4.....	54.4	57.02	April 15	April 24	9	28.77
96.4.....	54.8	56.85	April 15	April 28	13	25.11

Average time in the crystallizers for the crop ---------- 6 days.
Massecuites:
Average Brix ---------- 96.47
Average purity ---------- 55.53
Final molasses:
Average purity ---------- 29.64
Gallons per ton of cane ---------- 5.4

The slow cooling of the massecuites to the temperature of the air around the crystallizers was again a factor in producing final molasses of lower purities than the average for the crop.

Milling Season 1919–1920.

Massecuite			Date of boiling	Date of curing	Time of cooling. Days	Purity of final molasses
Brix.	Suc.	Pur				
96.4.....	54.4	56.43	Dec. 30	Jan. 10	11	26.67
96.8.....	54.6	56.40	Dec. 31	Jan. 13	12	26.61
96.8.....	54.8	56.61	Jan. 1	Jan. 14	13	26.09
96.4.....	55.2	57.26	Mar. 30	April 11	12	28.97
96.6.....	55.2	57.14	Mar. 30	April 12	13	28.10
96.4.....	53.2	55.19	Mar. 31	April 13	12	28.84
94.8.....	54.6	57.59	Mar. 31	April 13	12	28.44

Average time in the crystallizers for the crop .... 5.6 days.

Massecuites:

Average Brix 95.57

Average purity 56.20

Final molasses:

Average purity 28.67

Gallons per ton of cane 5

The final molasses corresponding to the 10th, 13th, and 14th days of January are noteworthy because of their low purities, after the long period of cooling during the stop of New Year and "Reyes" celebration. Those corresponding to April 11th, 12th, and 13th do not appear of so low purities; but it should be remembered that the ten immediately preceding crystallizers, cured after cooling periods varying from 4 to 6 days to temperatures from 45° to 35°C, gave higher final purities. The same was true in the case of the next ten crystallizers worked from April 14 to April 22.

It may be timely to copy here part of a page from our crystallizer record, where the analytical data of the third massecuites and the molasses yielded by each was recorded daily. It should be noticed that the massecuite corresponding to strike No. 304, which went into crystallizer No. 3, serial No. 73. on the 29th of March, was abnormal in that the concentration was not enough (94.8) and the purity too high (60.13). For this reason it was not included in the previous table in spite of its 12 days period of cooling in the crystallizer.

Crystallizer Record.

No.	Crystallizer No	Strike No.	Date filled	Massecuite Brix	Massecuite Suc.	Massecuite Pur	Date cured	Final Molasses Brix	Final Molasses Suc	Final Molasses Pur.
65 ..	1	270	Mar. 23	96.6	54.4	56.31	Mar. 27	91.2	27.9	30.59
66 ...	3	274	Mar. 24	95.0	53.4	56.21	Mar. 28	87.2	26.4	30.28
67 ...	4	279	Mar. 24	94.6	51.2	54.12	Mar. 28	79.8	23.2	29.07
68 ..	5	284	Mar. 25	96.2	53.6	55.72	Mar. 29	81.0	25.2	28.64
69 ...	6	287	Mar. 26	95.4	54.4	57.02	Mar. 30	82.0	25.6	31.22
70 ...	7	292	Mar. 26	98.6	56.4	57.20	Mar. 31	89.4	26.4	29.35
71....	8	296	Mar. 27	96.0	55.0	57.29	Mar. 31	89.4	26.4	29.53
72 ..	1	300	Mar. 28	96.4	53.0	54.98	Mar. 31	88.6	26 8	30.24
73....	3	304	Mar. 29	94.8	57.0	60.13	Apr. 10	88.0	26.8	30.45
74..	4	308	Mar. 30	96.4	55.2	57 26	Apr. 11	85.6	24.8	28.97
75....	5	311	Mar. 30	96.6	55.2	57.14	Apr. 12	85.4	24.0	28.10
76 ...	6	317	Mar. 31	96.4	53.2	55.19	Apr. 13	86.0	24.8	28.84
77....	7	320	Mar. 31	94.8	54.6	57.59	Apr. 13	87.2	24.8	28.44
78....	1	322	Apr. 10	96.2	52.4	54.46	Apr. 14	84.2	24.6	29.22
79....	2	326	Apr. 11	98.4	50.8	51.63	Apr. 15	88.0	28.8	32.73
80 ...	3	331	Apr. 12	96.6	52.4	54.24	Apr. 16	89.0	24.8	27.87
81 ...	4	334	Apr. 12	95.4	53.2	55.77	Apr. 17	89.4	25.2	28.19

Attention should be called to the massecuite corresponding to strike No. 326, which was given too much molasses, a mistake which resulted in an exceptional low purity of 51.63. Also it was brixed up too high; to 98.4° Brix. The said massecuite became too hard on cooling and it was necessary to bring down the concentration to about 95° Brix by addition of water. The added liquid was not run into the sugar with due care and some crystals were dissolved, thus yielding a final molasses with a high (32.73) coefficient of purity.

Notice, then, how different variations from the established routine may lower the efficiency of the process in regard to the exhaustion of the final molasses.

During the next milling season, 1920–1921, the same results were noticed in regard to the effect of abnormally long cooling periods of several third massecuites in the crystallizers.

Milling Season 1920–1921.

Massecuite			Date of boiling	Date of curing	Time of cooling. Days	Purity of final molasses
Brix.	Suc.	Pur.				
96.0.....	52.8	55.00	Mar. 18	Mar. 31	13	27.39
95.0.....	54.0	56.85	Mar. 19	Mar. 31	12	29.17
95.6. ...	56.0	58.58	Mar. 20	April 1	12	29.05
96.0.....	54.8	57.08	Mar. 30	April 11	11	28.04
94.8.....	56.4	59.49	April 2	April 14	12	27.49
95.8. ...	54.8	57.20	April 11	April 23	12	28.05
95.8.....	54.6	56.99	April 12	April 24	12	28.85
96.0....	52.8	55.00	May 28	June 9	12	28.14
96.0.....	54 6	56.88	May 28	June 10	13	27.27
95.2. ...	54.0	56.72	June 2	June 13	11	27.97

Average time in the crystallizers for the crop------ 5. 8 days.
Messecuites:
Average Brix ------------------------------------ 95. 76
Average purity ------------------------------------ 57. 50
Final molasses:
Average purity ------------------------------------ 28. 73
Gallons per ton of cane ---------------------------- 5

The data given above is not, of course, conclusive. We do not believe, however, that it is always profitable to carry the cooling of the low grade massecuites below 45°C.; but our experience seems to indicate that temperatures as low as 30°C. do not increase so considerable the viscosity of the mass, and that certainly the long periods of cooling after which such temperatures are obtained, invariably resulted in final molasses of lower purity. Even though crystalliza-

tion due to cooling is complete at 45°C., the retardation of the process in the air-cooled crystallizers seemed to be in our case profitable in spite of the lower temperatures obtained after prolonged cooling periods.

It should be understood that our experiments were carried on in closed-type crystallizers, with no water circulation; and that naturally no massecuite could be cooled to temperatures less than that of the surrounding air; which was usually around 30°C. Low-grade strikes which were carefully boiled and the viscosity of which was not above normal, always dried well at that temperature. Those massecuites which, because of careless boiling (false grain) or excessive viscosity were hard to cure after cooling, were always little improved by warming up or by the addition of water.

DILUTION OF OVER CONCENTRATED FINAL MASSECUITES.

The bringing down of the degree Brix or "doping" of the final goods in the crystallizers was practised in the Central whenever the concentration was found to be too high. Usually massecuites over 97° Brix were diluted to about 95° Brix before curing.

It may be well to remember that whenever a low-grade massecuite is overconcentrated, a condition which in our experience was found to be reached when Brixes of over 97° were obtained for 55–56 purities, the corresponding molasses have lost some of their normal moisture. The molasses of such massecuites, are, of course, supersaturated. It is, therefore, theoretically possible to add afterwards some water without disolving any of the crystallized sucrose; because the water is incorporated with the non-sucrose medium which, being hygroscopic, requires a certain amount of the liquid to reduce its concentration to normality. There should be, then, no solution of the sucrose crystals until an excess of water be present over the amount needed for the establishment of the hygroscopic equilibrium of the final molasses.

In our daily work it has been found that the addition of water, diluted molasses or any other liquid to the low grade massecuites always results in considerable melting of the previously crystallized sucrose with the corresponding increase in the purity of the final molasses. It is also true that the more carefully and gradually the liquid is added to the crystallizer, the less opportunities there will be to dissolve the sucrose crystals; but under the usual conditions of the sugar factory, with the known rushes and difficulties, it is wellnigh impossible for the Chemist to perfectly control the operation.

Some authors recommend the addition of dilute molasses. Prinsen Geerligs[1] cautions us that this should be done "in a judicious manner, until the compounds of sucrose with salts[2] have absorved their full proportion of hydration water." Personally we have not found any advantage in the use of dilute molasses over the use of pure water; furthermore we have always found it advisable to prefer the water alone, because of the fact that it produces the same effect without the necessity of preparing a molasses solution and also because it never was thought advantageous to add any more impurities over those already present in the massecuite.

Somebody has pointed out that dilute molasses has less dissolving action than water. We agree to the fact; but when the question—How much less?—is asked, the argument gets complicated. Our experience with both is convincing enough to warrant the statement that there is no advantage whatsoever in the use of the dilute molasses over the use of water alone.

The old-fashioned sugar makers or "maestros de azúcar" may consider this statement nearly sacrilegious. We remember well the expression of admiration and perplexity which was shown by an old centrifugal foreman in the Central when we ordered the piping for taking final molasses over the crystallizers to be taken down. Up to then final molasses could be discharged into a small tank over the set of crystallizers and there mixed with water, in such a way that the solution could be emptied through convenient pipes into any one of the crystallizers. Hence his surprise. He asked: "And . . . how are you going to cure the final massecuites . . . ? Don't you think it will be necessary to put up again the molasses pipe?"

We wanted to try out the effect of the water alone, without the possibility of having the man in charge of the crystallizers letting go "just a little molasses"—accidentally, you know—when desirable to lower the concentration of some strike. In this way we decided to burn our ships, and the molasses pipe was taken down. It was never missed during the following seasons.

It was found that the best method to add the water to the massecuite in the crystallizers was by letting it drip slowly, in such a way as to insure a uniform admixture of the liquid and the massecuite; so that at no time there be any "free" water around the

[1] "Cane Sugar and its Manufacture," by H C Prinsen Geerligs

[2] The presence of such compounds has been disproved by more recent investigations.

sucrose crystals long enough to dissolve some of the sugar. The liquid was preferably added during the day previous to centrifuging.

In the case of some very viscous final massecuites due to an abnormal high content of gums, massecuites which generally underwent frothy fermentation in the crystallizers, it was found that a solution of caustic soda at about 15° Brix could be used to advantage instead of water in order to reduce the concentration of the massecuite, diminish the viscosity and thus facilitate the curing.

It is probable that this solution has, in addition to the work of hydration previously mentioned, some chemical effect on the vegetable gummy material and other impurities in the molasses, and that this effect tends to check somehow the viscosity. The sodium may also replace the calcium in some organic salts, forming less viscous organic compounds. In the case of massecuites undergoing frothy fermentation the action of the hydrate of soda was worthy of attention. We suppose that the alkali added neutralizes the organic acids produced by the so called 'fermentation', thus helping to check the characteristic frothing.

FACTORS INDUCING FROTHY FERMENTATION.

Frothing of the low-grade massecuites in the crystallizer has been often attributed to the fact that the strikes are boiled at too high a temperature.[1] Our observations seem to indicate that this is not the one only determining factor inducing frothy fermentation; probably it is not the most important one, either. Our experience has been otherwise. We believe that certain impurities, which in our case were believed to originate in the poor quality of cane ground, have *as much* and perhaps *greater influence* on frothy fermentation. Slow boiling at temperatures of 145°F. helped somewhat, but in most cases this was not a sure way to prevent the fermentation. Our pan capacity was scarce and usually final boilings had to be ready to strike in five or six hours.

These impurities, mostly consisting of viscous vegetable gums, were very often present in our low-grade massecuites in such a high proportion as to cause violent frothy fermentation in the crystallizers in spite of all precautions taken to maintain reasonably low temperatures while boiling. These impurities, which were collectively grouped under the name of "gums," hindered very much the

[1] Frothy "fermentation" is here discussed as a chemical reaction Our experiences warrant the belief that it is not a result of the action of either yeast or bacteria.

drying of final sugars, causing sometimes troublesome difficulties at the centrifugals.

WORKING JUICES OF LOW PURITY.

We have good reasons to believe that an important factor in bringing about an abnormal content of gummy impurities in the final goods was the poor quality of the cane ground during the discussed milling seasons. This question requires some kind of "historical" explanation.

In the year 1918, the price of sugar being already on that upward flight which culminated in the undreamed of prices of 1920, there was of course great demand for *colonos'* cane[1] without any regard almost as to its price and quality. The growers sold their cane at so much per cent sugar on the *weight of the cane,* and therefore they did their best to send to the mills as much *tonnage* as they possibly could.

It was only to be expected, then, that the cane coming to the Central had incorporated with it a large percentage of top seed and even plain green tops, at times including some parts of the leaves. The cane also contained a large amount of dirt and trash. Oftentimes it was entirely unripe. The price of sugar, nevertheless, gave ample margin for it all. Sugar chemists, generally, protested at such a state of things and called attention to the fact that such canes were detrimental to the best general recovery; but it was certain that, in spite of all this, good profits were being made and the managers and owners of the mills were satisfied. It was good business to grind and grind to full capacity.

The result, naturally, was a season of exceptionally low purities; so much so that the following year some Centrals which were buying *colonos'* cane began to take measures to stop the evil.

Guánica Centrale, the largest mill on the Island, made during the crop of 1918–19 a very interesting study of a few wagon loads of *colonos' cane.* These wagons, six in number, were unloaded separately in the plaza of the Central after each was carefully weighed. All trash, earth, seed and suckers were separated and weighed. The juice from each wagon of cane was analyzed and also the juice of the seed cane corresponding to each load.

[1] Cane bought from growers on percentage bases.

The following table gives in quite a convincing way the result of the experiment:

Comparative Analytical Data of Six Wagon Loads of Colonos' Cane, unloaded in the plaza of Guánica Centrale with separate weight of trash, seed, etc. (Milling Season of 1918–19.)

	Pounds					Percentage					Analysis			
											Mill juice from cane		Mill juice from seeds	
Car No	Total weight	Trash	Seeds	Earth	Suckers	Trash	Seeds	Earth	Suckers	Total	Suc	Pur	Suc	Pur
K-517.	28.510	824	1.080	......	...	2.89	3.78	...	. ...	6.67	15 0	82.8	4.5	88 1
CF 325.	33.910	708	2.471	18	.	2.098	7.286	053	.	9.482	11.3	86 2	4.8	88.1
324.	31.299	572	1.488	39	...	1 83	4.75	012		6 592	13 0	78.6	1 6	19 1
489	29.714	660	1.514	......	.. ..	2.22	5.09	... ..	... ..	7.81	16.0	86 3	7.6	58 5
389.	32.309	598	1.681	....	370	1 851	5.20	.....	1 14	8 191	10 0	65.1	1 4	16.1
777.	28.555	527	708	.....	...	1.8	2.4	....	.....	4.2	13.2	70 8	2 9	24.8
6 cars	184.297	3.884	8.942	57	370	......	.....	.....	.....	. ...	...	....	......	......
Avgs.	30.716	647	1.490	10	62	2.11	4.75	.011	19	7 07	13.1	78.3	3.8	31.6

No comment need be passed over the said table. Central Boca Chica, on our recommendation, reprinted the data obtained at Guánica and sent copies to each one of her *colonos*, accompanied by a circular letter of explanation. It might be of interest to copy here the said letter:

CENTRAL BOCA CHICA,
PONCE, P. R., *November 1919.*

MY DEAR SIR:

We must inform you that during the last milling season, 1918–1919, the cane sent by some *colonos* to this Central arrived here in very poor condition, with large amounts of seed, suckers, trash and dirt. Guánica Centrale, which met with the same difficulty, unloaded six wagons of cane in the *plaza*, separated the cane from the seed, trash, etc., and made a separate analysis of each portion in their chemical laboratory.

Please notice that there is an average total of 7.07 per cent trash, seed, suckers and dirt; also that the juice extracted from the "seed" is of exceedingly low purity and sucrose, namely 3.8 per cent sucrose and 31.6 per cent purity; It is ruinous to pay for such material as if it were a good sugar-producing cane; but the matter is worse yet if we consider the fact that such impure juice usually contains high percentages of non-crystallizable sugars, vegetable gums, mineral salts, etc., which, when mixed with juices of normal composition, hinder the process of fabrication, causing, therefore, larger losses to the Central.

Moreover, we beg to call your attention to wagon C. F. 325. With a net weight of 33,910 pounds of cane there was in it an amount of 3,198 pounds of seed, suckers, trash and dirt which the Central paid for as good sugar-yielding cane. The truth is that such material did not produce any sugar; but, on the contrary, made it impossible to recover a certain amount of the sucrose present in the good canes, as both these juices were mixed at the mill.

We are fully acquainted with the good faith which accompanies all your

business transactions, and do not doubt that you will understand and accept our reasons in requesting that the *colonos* who grind their cane with us during the coming season, 1919–1920, see to it that the cane be sent perfectly free from seed, trash, suckers and dirt. This request is fully in accordance with our grinding contract. We believe we are justified in stating that the said contract has been fully kept by us in all its parts, and therefore we are entitled to expect that you observe it as well.

Your very truly,

(Signed) M. León Parra,
Manager.

Attention is given to such details because they show that we were getting poor quality of cane and that the factory had, therefore, to work with juices of low purity, which means a proportional abundance of final molasses.

Our centrifugal capacity was not sufficient.[1] We found ourselves during the crop of 1917–1918, in great difficulties to get rid of the impurities that came in the juices and which it was impossible to remove in the process of defecation.

By this time we had already installed the necessary machinery to go into the making of magma as a routine in the process. It was expected, of course, that the final molasses were going to be of lower purity than before. This was accomplished; but under great difficulties, up to the first days of May.

Up to this time we had noticed an excessive viscosity in the final massecuites, a viscosity which was more troublesome at times. Some final massecuites with normal brixes and purities, which did not have any false grain, nevertheless took much time to dry in the centrifugals. As we were working magma, the sugars were dumped only partially dried or "wet," so that only the well-exhausted molasses be removed from the massecuite.

We have already explained how we tried to facilitate the curing of such low-grade massecuites by diluting in the crsytallizers with water and with weak solutions of hydrate of soda. The time that the massecuite stays in the crystallizer and the limitations of its effect on the centrifuging have also been discussed.

It is important that we state now that great care was taken to control properly the liming, heating, and defecation of the juices. This was done in order to be sure that the high viscosity of the final molasses was not due to defficient clarification. The juice was limed until the reaction was slightly alkaline, using phenolpthalein

[1] Our centrifugal outfit for final goods consisted of six 30-inch Mackintosh centrifugals. Cane ground was around 520 tons each 24 hours.

as indicator; then it was pumped through heaters so that the temperature was raised to 215°F., a degree of heat which has been found elsewhere[1] to be fully sufficient to obtain good clarification. Defecation of the juices, was, therefore good, and it was not here that the difficulties could be remedied.

The problem was, then, to be solved at the centrifugals, if it was desired, on the one hand, to keep the purity of the final molasses under 30°; and, on the other hand, to keep the factory grinding at full capacity.

The question before us was, hence, the following: How to separate from the low-grade massecuites the viscous substances which hinder the process of curing.

[1] I S J 1922, pp 638 to 639

II.

DIFFERENTIAL CURING OF FINAL SUGARS.

The idea occured to us, then, that it would be worth while to look for some new way to facilitate the curing of those sugars, which took too much time to dry by the ordinary centrifugal method. We had found out that some final massecuites which contained too much gummy material would be free from the more fluid, less viscous molasses during the first ten or fifteen minutes of the centrifugal process; but, also, that these gummy sugars would afterwards rotate in the centrifugals for thirty, forty or fifty additional minutes without getting rid of the gummy molasses or "gums."

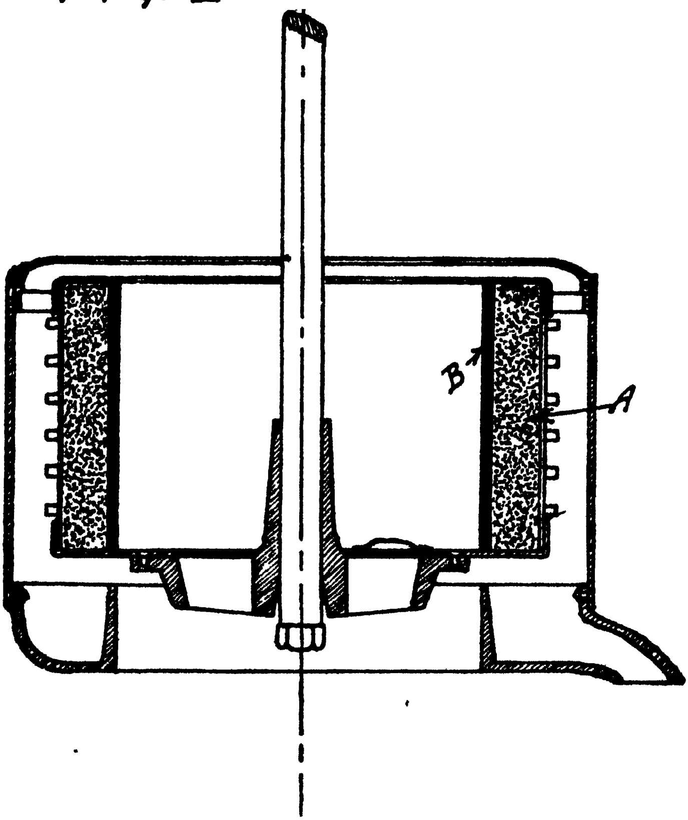
It was clear that two distinct layers were formed in the massecuite as it adapted itself to the centrifugal basket; layers evidently arranged according to their corresponding specific gravities. The sugar crystals and the heavier molasses formed a layer (A) about three inches thick, immediately against the sides of the screen On the outer side—the nearest to the centrifugal shaft—there remainded a second layer (B), consisting of gummy, very viscous material, spongy in texture and of very low purity. These impurities could be turned around in the centrifugal machine almost indefinitely without passing through the layer of sugar, in spite of the fact that the massecuites in layer (A) was practically free from molasses, and also in spite of the fact that—and this is very important, we are sure—the massecuite did not have false grain.

If the centrifugal machine was stopped after running ten minutes or so, it was observed that while the sugar forming layer (A), already free from molasses and ready to be discharged, stayed strongly adhered to the sides of the basket, the gummy impurities of layer (B) flowed down to the bottom of the centrifugal and, if the discharge valve was opened, the gummy molasses fell into the sugar conveyor.

The idea of doing away with these impurities by letting them flow down by gravity and collecting them in special wide canals, was the immediate and logical result. The first gummy molasses

extracted by this method from a 30-inch Mackintosh centrifugal gave a volume of 1½ gallons with a weight of nine pounds.[1]

FIG. I



[1] The small weight of this material is due to its spongy texture, the mass often containing a large amount of very minute bubbles (mostly CO2 gas) incorporated in it. Its low specific gravity is, hence, only apparent.

The polarimetric analysis of the material thus obtained was as follows:

Brix	91.6
Sucrose	22.4
Purity	24.45

The final molasses obtained by centrifugal force gave the following analysis:

Brix	89.3
Sucrose	25.6
Purity	28.67

The separation of 90 per cent of the gummy material constituting layer B, a material which would not pass through the centrifugal in 30 or 40 minutes sometimes, was disposed off by the gravity method in less than ten minutes. The centrifugal basket was then set in motion for a few minutes, five or six, and finally the sugar was free from molasses and "gums" and ready to be discharged.

One of the trays used to collect the "gums".

This fact called strongly upon our attention. Immediatedly an attachment was devised for our centrifugal machines. With the help of this attachment we succeeded in separating the gummy molasses with comparative ease making use of the force of gravity in addition to the centrifugal force.

The method finally adopted for the work was as follows:

Each centrifugal was charged and put in motion for ten minutes more or less; then the machine was stopped, when the layer of sugar (layer A) was sufficiently free from molasses. After a little practice, the men at the centrifugals could easely tell, by "cutting" the sugar in motion with a wooden paddle, if the sugar in layer A was free enough from molasses to be stopped for the removal of the "gums."

Once the basket was not in motion, the gummy molasses began to flow down; the workingmen helping to accelerate the flow by

pushing gently with the palm of the hand or the familiar wooden paddle used for hand discharging of the sugars.

The "gums" came out through the discharge valve of the centrifugal basket and were received in special receptacles sustained under the basket for the purpose, in a manner which will be explained later. The machine was set in motion for five or six minutes and then the final sugar was dried enough and ready to be discharged in the usual manner.

It was found that there was always a notable difference between the gummy material and the usual molasses extracted by centrifugal force. Of course, we were not washing at all while curing the final sugars. The difference in purity between the normal molasses and the "gums" was generally about three points.

There may be some interest in the following comparative table including analyses of twenty molasses and the corresponding "gums" taken from the same centrifugals. With the object of getting uniform and representative samples, the portions of molasses to be analyzed were taken five minutes after the particular centrifugal was in motion and at full speed. From the same centrifugal was then taken the sample of "gums" as separated by gravity in the manner already explained.

Comparative Table of Some Final Molasses and their Corresponding "Gums."

Analysis of the molasses			Analysis of the "Gums"			Difference in purity
Brix	Sucrose	Purity	Brix	Sucrose	Purity	
90.2..	26.2	29.05	91.0	23.4	25.71	3.34
89.0 .	24.6	27.64	91.8	23.2	25.27	2.37
89.2.	25.6	28.70	90.6	23.0	25.38	3.32
89.3..	25.4	28.56	91 2	24.0	26 31	2.25
88.6..	24.4	27.54	91.7	22.8	24.86	2.68
89.8..	25.0	27.84	93.6	22.8	24.35	3.49
90.5..	26.2	28.95	92.0	23.6	25.65	3.30
89.2..	24.2	27.13	90.8	21.2	23.34	3.79
89.6..	24.4	27.23	91.6	22.4	24.45	2 78
90.7..	26.0	28.67	92.8	22.8	24.57	4.10
90.2..	25 8	28.60	92.7	23.6	25.45	3.15
91.3..	26.4	28.92	92 9	23 8	25.61	3.31
89.8..	24.6	27.40	91.2	22.4	24.56	2.94
90.3 .	26.2	29.01	92.0	24.6	26.74	2.27
92.1..	26.8	29.10	93.4	24.0	25 69	3.41
90.7..	25.6	28.22	92 3	22.0	23.83	4.39
88.9..	24.2	27.22	90.4	21.0	23 23	3.99
91.4..	26.8	29.32	92.6	24.2	26.13	3.19
90.6..	25.2	27.81	93.2	22.8	24.46	3.35
90.2..	24.8	27.49	91.9	22.2	24.15	3.34

These gummy molasses may sometimes be of higher purities, a fact which seems to indicate that once the troublesome impurities are accumulated in the factory it would not be of much help to raise the purity of the final boilings. This was found to be true in our case. Final massecuites of 58 and 60 purities have oftentimes yielded very viscid molasses, which were separated by gravity and had coefficients of purity of 32 in the gummy portion.

A more or less low sucrose content does not appear to be the determining factor in regard to the viscosity of the molasses. We found that a high content of mineral salts and vegetable gums is generally associated with viscid and gummy molasses. This may be inferred from the following analysis of representative samples made by the author and other analysts.[1]

Analysis.

Sample No	1	2	3
Brix	92 8	93.3	93.6
Polarization	22.8	28.1	30.2
Purity	24.56	30 11	32.26
Reducing sugars	15.96	14.58	14.58
Ash	16.22	12.04	12.12
Vegetable gums	3.45	2 82	3.07

This viscid material is, to be sure, the last one to separate from the crystals in the ordinary process of centrifugation. Regularly it remains adhered to the grain of sugar and goes into the magma mixture, thus returning again to the pans. It does not make any difference whether the magma sugars be dried to the bag or taken into the pans as seed for first and second boilings; anyway the impurities are bound to circulate in the factory and will accumulate if not properly expelled from the house in the final molasses. The importance of maintaining this equilibrium between the income of impurities in the cane juice and the outgo of impurities in the final waste products is generally recognized.

The low purities of the juices with which we had to work, together with an insufficient centrifugal capacity, were united to aggravate *our problem.* To solve this we were helped by the attachment for the centrifugal outfit which we devised and used at the Central.

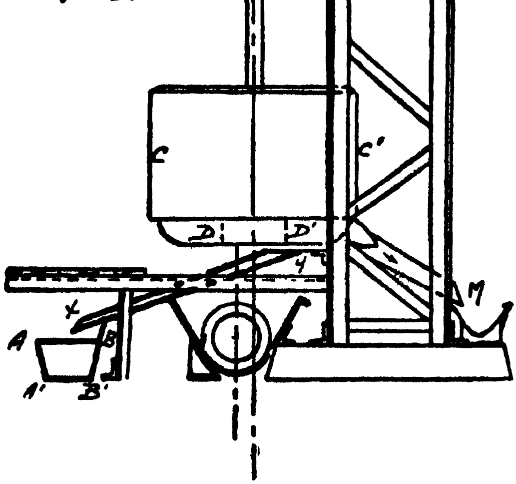
[1] The author wishes to thank the following cooperators for some determinations in these analysis: Mr. J O. Carrero, of the Federal Experiment Station, at Mayagüez, and Messrs. F. Colón Moret and H. J Ramírez, of the Insular Experiment Station.
Sample No. 1 was taken and analyzed by the author in February 1921; samples Nos. 2 and 3 were secured during the last milling season (February 1923), when the author was not in control of the factory.

The accompanying drawings will serve to give a clearer idea of our centrifugal attachment. It consisted of:

(1) Three wide trays (one for each two centrifugals) shaped somewhat like a trapezoid; movable from under one centrifugal basket to another.

(2) A long, narrow canal, situated alongside and in front of the canal of the screw conveyor.

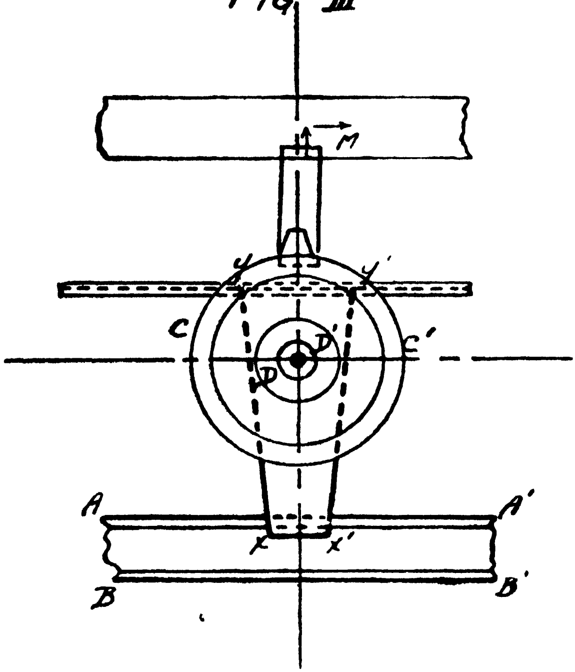
Fig. II



The wide trays (Fig. II and III, lettered XYX'Y') had the form of a trapezoid, 24 and 28 inches at the bases and 30 inches in height. They had on each side, right and left, walls about three inches high to prevent the gummy molasses discharged into them from running out at the sides. A lip at the smaller base, which was the one (Fig III, XX') discharging into the long canal recipient of the molasses, was fixed so as to facilitate the discharge. The trays were made of zinc plate at the shop of the Central. They were, therefore, light enough to be easily managed, even by a boy.

The molasses canal (Fig. II and III, ABA′B′) was made of wood. It was approximately 10 inches wide, 8 inches deep, and ran parallel to the screw conveyor canal, along the front of the centrifugals, and under the platform where the centrifugal workers stand (see Fig. II). Into this canal were discharged the gummy molasses and through it they flowed slowly towards the final molasses tank. In this tank the "gums" were mixed with the less viscous and richer final molasses extracted by centrifugal force, molasses

FIG. III



which went there by the usual canal situated back of the centrifugal baskets.

In this tank the mixed molasses were heated with exhaust steam in order to reduce their viscosity and to facilitate the pumping up to the molasses scales and out of the factory. Because of this heating, when considerable condensation water from the exhaust steam was incorporated into the molasses, the commercial molasses always appeared with a concentration (85° to 88° Brix) lower than the samples taken directly at the centrifugals.

During the milling seasons of 1917–18, 1918–19, and 1919–20, this method of curing very gummy final massecuites was used by the author, always with excellent results. The effect was oftentimes surprising; not only because the final sugars thus obtained were practically free from any gummy, viscid impurities, but also because magma mixture made with such final sugars and second molasses (about 46 purity) resulted every time in a much looser, freer mass; a mass which did not foam at the mixer, which purged freely without any previous heating, and yielded commercial sugar of 94°–95° polarization without excessive washings. The resulting molasses (magma molasses) was of very low "gum" content—very contrary to the case when the gummy molasses were not removed from the sugars previous to the making of the magma mixture. These molasses were apparently like second molasses; their purity generally being about 40.

Magma molasses, as we have already explained were mixed with the second molasses and were reboiled over syrup grain to make third massecuites, of about 56 purity, which were to go into the crystallizers to cool. The final massecuites thus boiled in general did not undergo frothy fermentation; about one crystallizer out of ten did show the characteristic fermentation, while formerly it was taking place in about nine out of ten strikes.

In the presence of final massecuites of great viscosity which cannot be otherwise prevented or disposed of, this method of differential curing of final sugars has undeniable advantages. Our experience has been such as to repeatedly test its advantages which may be summed up as follows:

1. Saving of time in the process of curing.

2. Separation of a very large part of the gummy impurities which resulted in—

(*a*) A looser magma mixture which is less viscous and of higher purity. This, of course, implies easier drying of magma sugars, and a better magma molasses.

(*b*) Better final massecuites which dried freely and which generally did not undergo frothy fermentation in the crystallizers.

3. A smaller quantitiy of molasses per ton of cane.

As may be seen, a factory can be cleaned from impurities in this manner without falling back on the old, wasteful method of drying to the bag the whole set of crystallizers. The chief difficulty with the magma process is the continuous circulation of impurities in the boiling house. Such difficulty and that of the trouble in curing

gummy magma mixtures is entirely obviated by the removal of the excessive "gums" at the centrifugal.

We feel justified in stating that, by the method here discussed, any sugar house can be free from gummy impurities in a few days by curing the entire set of crystallizers in that manner. Little by little, we found out, the impurities began to accumulate and to give trouble in the factory; hence, after two months or so, it was necessary to resort again to the "apparatus for the gums" (*el aparato de la goma*), as the attachment was called by the workers.

Our attachment is, evidently, rudimentary. Certainly some better mechanical arrangement can be devised to collect the gummy molasses as they flow out of the centrifugal baskets, in such a manner that all the outfit can be handled by laborers at the centrifugals, easely and efficiently. Even with the crude outfit we had, there was little difficulty in its working. The laborers at the centrifugals soon learned to operate the attachment, and very often they themselves notified us of the need of it—"because there was much 'gums' in the sugars."

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THE STATUS OF PLANT PATHOLOGY IN PORTO RICO

BY

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THE STATUS OF PLANT PATHOLOGY IN PORTO RICO.

By MELVILLE T. COOK.

Within the past half century, the study of the causes of plant diseases and methods for their control, has risen from an insignificant phase of botany to one of the most important subjects of agriculture. Plant diseases are referred to in the early writings of the Greeks, Romans and other ancient peoples but their observations cannot be said to constitute the beginnings of plant pathology. No very great progress was made until the invention and development of the microscope, during the sixteenth century, made it possible to study minute organisms. The period from the early part of the sixteenth to the latter part of the nineteenth centuries was marked by the rise of mycology, that branch of botany which was to be the corner stone of our modern plant pathology. The nineteenth century also saw the remarkably rapid rise of that sister science, bacteriology, under the direction of the master mind of Pasteur.

Plant pathology grew out of mycology during the latter half of the nineteenth century but bacteriology and other sciences have contributed to its rapid development. It is by means of these sciences that we are able to explain the causes of many diseases of plants and to determine the character and time of the treatment. The early efforts to control plant diseases were influenced by ignorance, superstition and the religious ideas of the times. The first great step in the control of diseases was made in 1882 when Millardet of Bordeaux, France, demonstrated the possibilities of a fungicide which has been greatly improved and is now known as "Bordeaux mixture."

During the last half of the nineteenth century many botanists in the United States were devoting the major part of their time to

the study of fungi; and many others, especially those connected with the agricultural colleges and agricultural experiment stations, were studying the causes of, and control of plant diseases. The natural outcome of these studies was the formation of departments of plant pathology in many colleges and universities and finally the organization of the American Phytopathological Society in 1909. Plant pathology was soon recognized as a most important science with a direct bearing on the economic welfare of the people. It was during this period of intense interest in the new science that the Spanish-American war was fought and Porto Rico became an integral part of the United States. Agriculture being the industry of primary importance in Porto Rico, the new science was called on to play an important part in the agricultural and educational policies of the United States Government in the new territory.

The contributions to our knowledge of mycology in the American Tropics previous to this time were few and imperfect. Some few collectors from both Europe and America had visited the Tropics and made collections of taxonomic importance; some resident workers had made contributions; and specimens which were sent to Kew Botanical Garden and other botanical centers had been the subjects of a number of papers. Although very few of these studies were made in Porto Rico or on Porto Rican material, they are of more or less interest in studying the mycological and pathological problems of the Island.

Porto Rico became a part of the United States at a time when plant pathology was just beginning to be recognized throughout the world as a most important science; at a time when plant pathology was just entering a period of great development in the United States. At this time there were no professorships of plant pathology in the United States but a number of departments of botany were giving courses in the subject and a number of agricultural experiment station workers were studying the control of plant diseases. The result was that Porto Rico received the benefits of this new movement and the importance of investigations in the mycology and plant pathology of the Island was immediately recognized as a part of the policy of the United States Department of Agriculture. The establishment of the Agricultural Experiment Station at Mayagüez (1900) gave immediate recognition to the importance of research; and the establishment of the College of Agriculture at the same place (1911) gave the youth of the Island an opportunity to study this most important subject. The sugar growers of the Island were

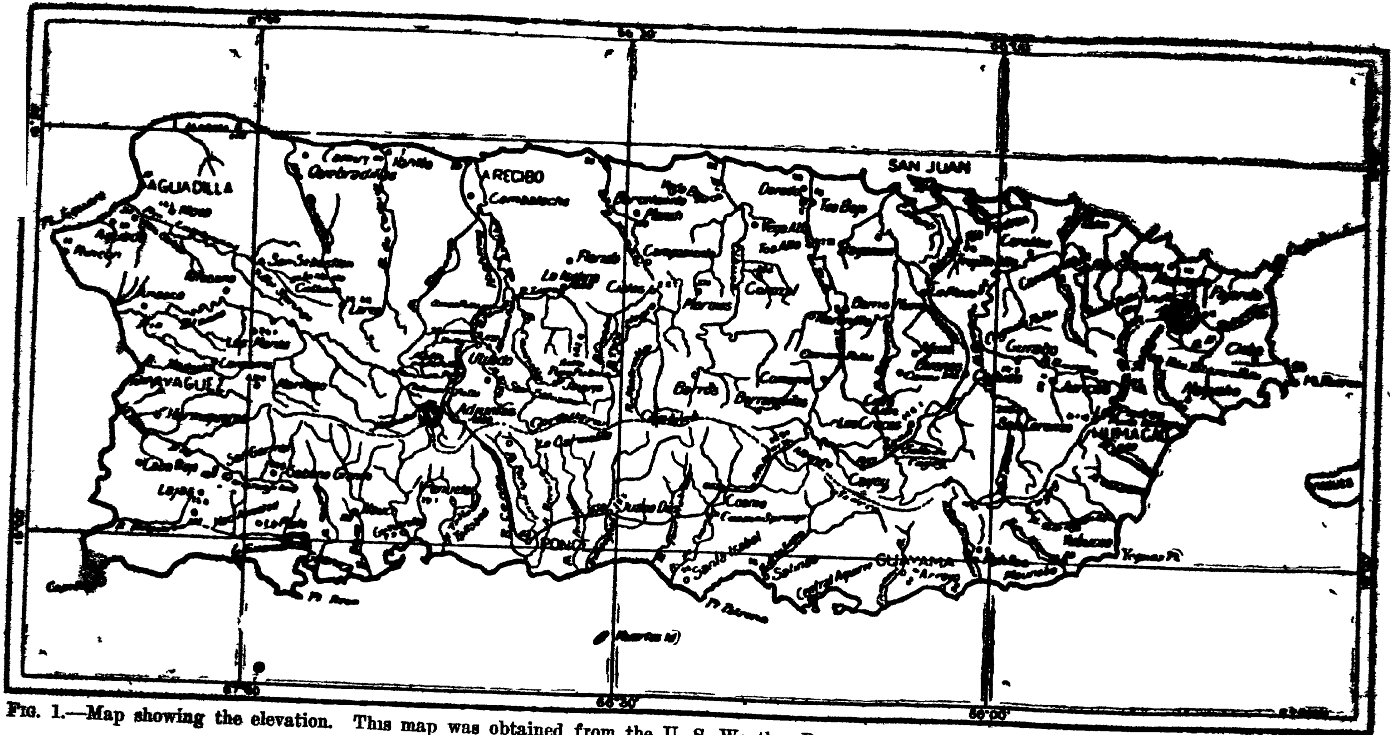

FIG. 1.—Map showing the elevation. This map was obtained from the U. S Weather Bureau office in San Juan. The elevations are from the same and other sources.

not slow to recognize, among their other problems, the very large losses due to plant diseases and the necessity for research along these lines. Therefore, they established the Sugar Planters Experiment Station at Río Piedras in 1910 which became the Insular Experiment Station in 1917. But the work of these three institutions does not tell the complete story of the rise of mycology and plant pathology in Porto Rico. Many scientific workers in the United States were interested in the Tropics in general and especially in Porto Rico and several of them have visited the Island from time to time and made more or less extensive studies.

Before taking up a discussion of the work of these institutions and men, it is desirable to give some attention to climate, topography and agricultural crops of the Island. Porto Rico is almost rectangular in form, about 100 miles east and west and 36 miles north and south and therefore consists of approximately 3,600 square miles, which at this time supports a population of 1,300,000 or more. It is very mountainous, some peaks reaching a height of 3,500 or 4,000 feet. The main mountain chain extends east and west and the water shed is about 10 or 12 miles north of the south coast but curving in a northeastern direction near the east end and extending almost to the north coast. Approximately two-thirds of the Island lies north of the water shed. This ridge or water shed gradually increases in altitude from its western extremity to Adjuntas where it is approximately 2,000 feet in height. This elevation is maintained to Aibonito. From this point the elevation gradually drops to about 500 feet. This altitude is maintained until near El Yunque at which point it rises rapidly to about 3,600 feet. El Yunque is usually referred to as the highest point on the Island but it is claimed by some that the highest point is near Los Picachos which is said to be about 4,300 feet. Numerous smaller ranges branch off to the north and south from this main range. Most of the rivers run north or south dependent on whether they are north or south of the principal range, the longer and larger being on the north coast Of course the rivers are in the valleys between these north and south ranges; the larger and longer ones flow north while the shorter ones flow south. There are 51 rivers and more than 3,000 smaller streams, but none of them navigable; in fact the larger ones can scarcely be dignified by the name of "river," except during the periods of high water, when they become mountain torrents. The character of soil varies greatly; in some places it is derived primarily from the igneous rock while in other places it

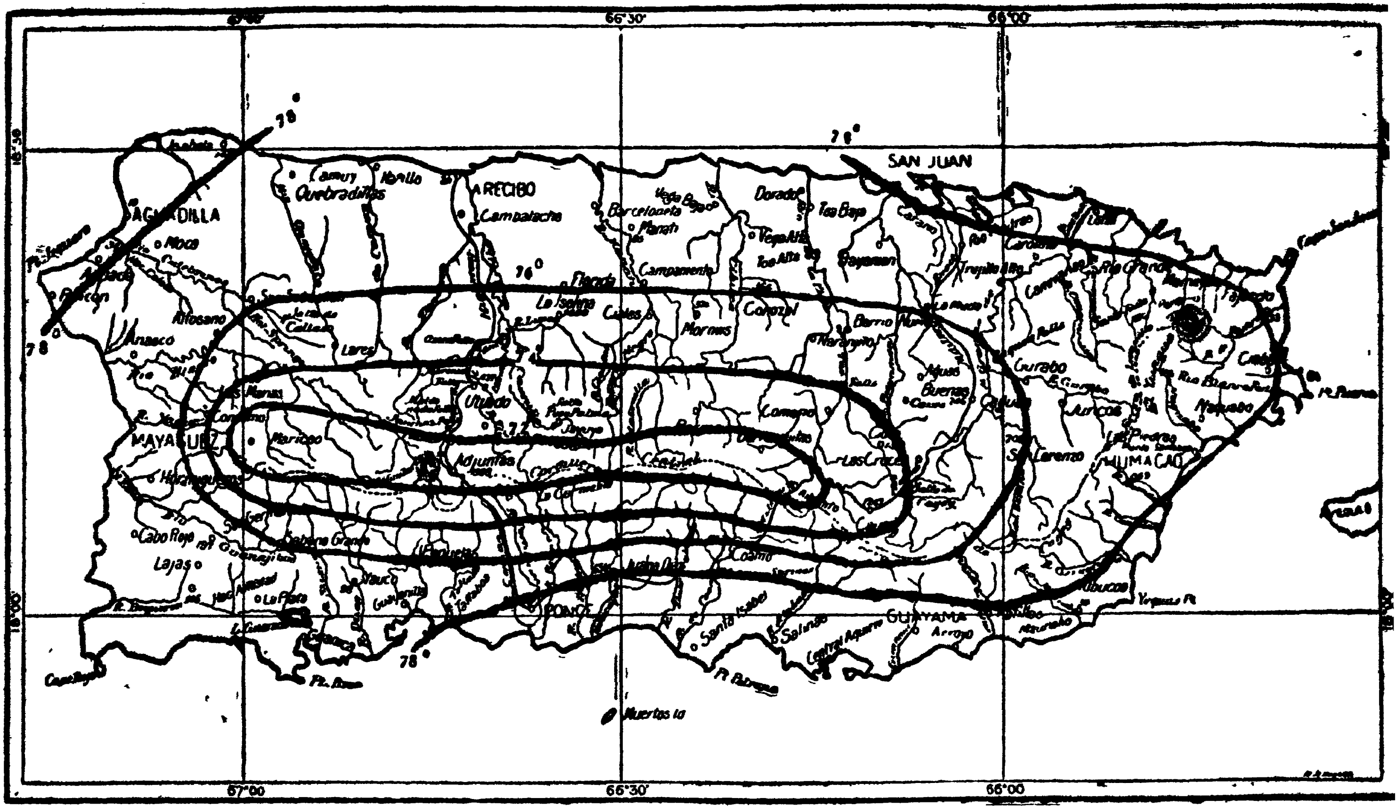

Fig. 2.—Map showing the mean annual temperature from 1899 to 1923. Obtained from the U. S. Weather Bureau Office in San Juan.

has evolved from the lime-stone formations. To these must be added the coastal plains and the numerous mixtures.

The prevailing winds in this part of the world are from east and northeast and the regularity is surprising to the visitors from the States. They are important factors in relation to the temperature and rainfall. The air is practically saturated at all times.

The average annual temperature for the coastal plains for a period of twenty-four years was 78°; for the elevations of 2,000 to 3,000 feet it was 72°. (See figure 2). During the same period the extremes of temperature were from 51° in some of the highest points to 94° in some of coastal regions. Although the temperature is somewhat higher during the summer than during the winter it is remarkably uniform throughout the year.

The rainfall depends on the heat which carries the moisture upward into the colder strata of air, thus bringing about precipitation. The moisture is carried in by the winds from the east and northeast until it is checked by the mountains, rises into the colder strata of air and falls as rain. The result is the excessive rainfall in that part of the Island north of the water shed. A study of the map (Fig. 3) will show this point and also that the rainfall is correlated with the elevations.

These variations in elevation, temperature and rainfall give most striking variations in vegetation; that on the north side being abundant and tropical in character while that on the south side is characteristic of warm, semi-arid regions. In fact in some places, especially in the southwestern part, the country is almost barren for long periods except for cacti. However, agriculture is practiced very generally on the south side with the aid of irrigation. In some places the transition from a vegetation of the luxuriant type, characteristic of high temperature and heavy rainfall, to that of the warm, semi-arid regions occurs within the very short space of two or three hundred yards. When we look upon this wonderful display of mountain scenery, of fertile valleys and of rich, varied vegetation, we are not surprised that the late President Roosevelt called it "the Switzerland of America," although it is without the snowy peaks of that "wonder land."

The principal crops are: sugar cane which is value at nearly one-half the total agricultural interest of the Island; coffee, amounting to more than one-sixth; fruits and coconuts amounting to about one-ninth and tobacco amounting to about one-eleventh.[1]

[1] According to the U. S. Census Report for 1920, the 1919 production was:

The sugar cane is grown in the coastal and alluvial plains and in the rich valleys. It is also grown to some extent in the hills, especially in the eastern part of the Island. On the south side this production is carried on largely by means of irrigation. It almost completely girdles the Island. The coffee is grown in the higher elevations, the greatest production being in the western half of the Island. The fruits are scattered throughout the Island, the most important citrus district being in the vicinity of Bayamón which is south of San Juan. The coconuts are found in all parts of the Island but are most abundant along the sea-coast. The tobacco-growing industry is most important in the east central part of the Island; in a region extending from Juncos on the east to Naranjito and Aibonito on the west. Forage crops of various kinds are grown quite extensively throughout the Island for the feeding of livestock. However, there are many other crops grown on a small scale, such as cotton, rice and fruits of various kinds. The Island also produced surprising large quantities of wild fruits.

Although the difference in temperature in different parts of the Island are comparatively slight, it will be readily seen that the variations in soil and rainfall make possible the growing of a great variety of crops and a very rich tropical flora. All these conditions are favorable for the production of fungi and plant diseases.

The development of plant pathology in Porto Rico naturally falls into two divisions: the period under Spanish rule and the period since the Island became a part of the United States—twenty five years ago, July, 1923.

The work of the period under Spanish rule has been stated by Stevenson [1] as follows:

"The earliest recorded collection of the fungi of Porto Rico was made in 1854 by Carl Schwanecke, for the most part in the vicinity of Humacao and the specimens were determined by Klotzsh, who listed them in Linnaea.[2] It was not until 1884–87 that further collections were made, during which period P.

Sugar Cane	$31, 808, 880
Coffee	11, 707, 391
Fruits and coconuts	7, 074. 429
Tobacco	5, 599, 678
Vegetables	4, 340, 247
Cereals	1, 392, 591
Other seed crops	1, 007, 582
Grass and forage	730, 018
Cotton, etc.	201, 362
	$63, 862, 178

[1] Stevenson, John A.—A Check List of Porto Rican Fungi and a Host Index. The Journal of the Department of Agriculture of Porto Rico. 2: 125–264. (July 1918).

[2] Klotzsch. J Schwanecke.—Collection of fungi. In Linnaea, 25 · 364–366 (1852).

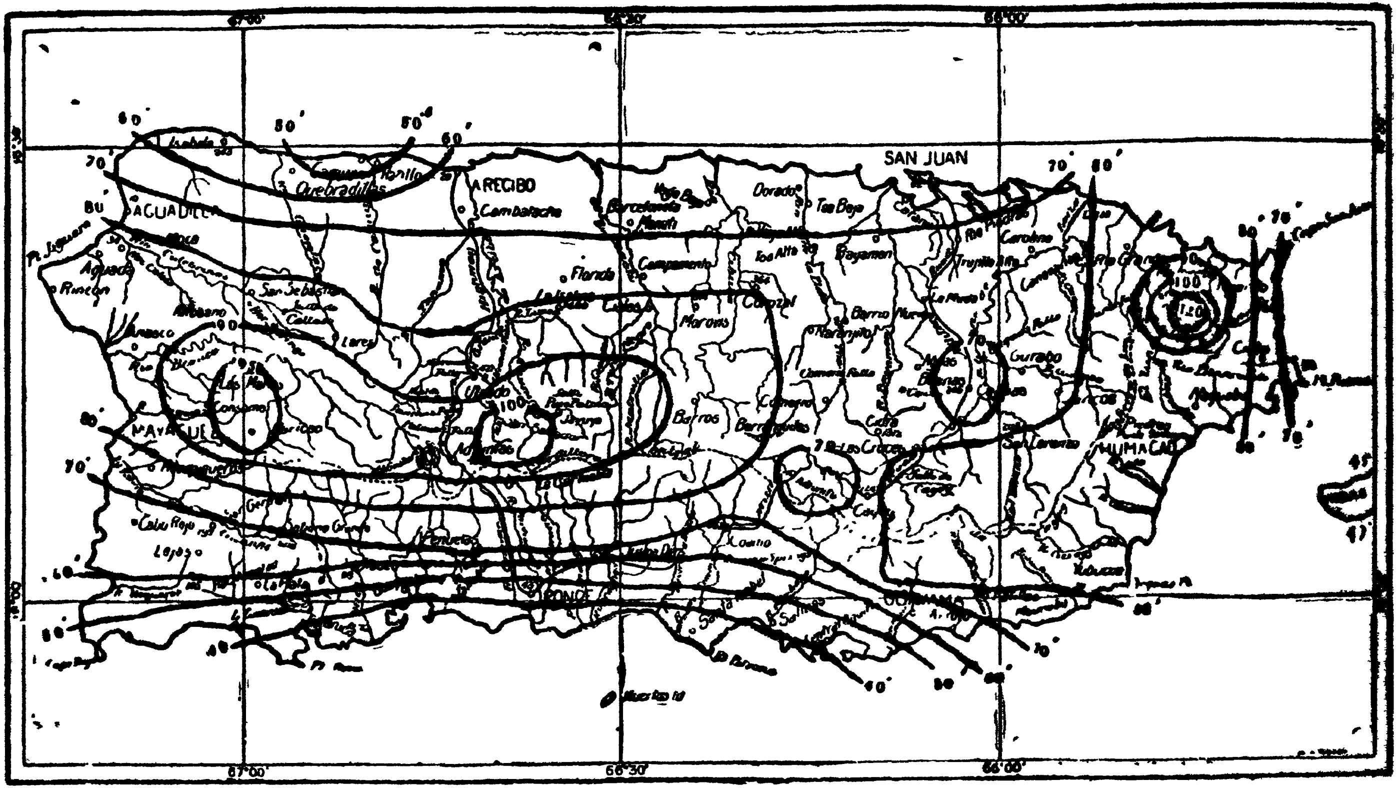

FIG. 3.—Map showing the mean annual rainfall from 1899 to 1920. Obtained from the U. S. Weather Bureau office in San Juan.

Sintenis visited various parts of the Island. The fungi gathered by him were worked over by J. Bresadola, P. Hennings and P. Magnus and their determinations were published in 1893.[1] A recompilation of these two lists was given by Heller[2] in 1900.''

To these publications we should probably add ''Informe Dado a la Excelentísima Diputación Provincial sobre la Enfermedad de la Caña de Azúcar, en el 4°. Departamento de la Isla de Puerto Rico por los Comisionados al Efecto Doctores, D. C. Grivot Grand-Court y D. Agustín Stahl y el Licenciado D. José J. Acosta y Calbo.'' (June 1878). This publication does not mention fungi and it is probably that some of the troubles to which it refers were caused by insects.

The second period began soon after the American occupation (1898) and at a time when plant pathology was emerging from botany and developing into a separate, if not distinct branch of study and research. Those who have served as plant pathologist on the Island since that date are as follows:

Agricultural Experiment Station at Mayagüez:

1. O. W. Barrett, Botanist and Entomologist—1901–05.
2. W. V. Tower, Entomologist and Plant Pathologist—1906–07.
3. G. L. Fawcett, Plant Pathologist—1908–14.
4. E. W. Brandes, Plant Pathologist—1915–16.
5. L. R. Hesler, Plant Pathologist—1917.
6. E. H. Thomas, Plant Pathologist—1917–18.
7. C. M. Tucker, Plant Pathologist—1923.

Agricultural College, at Mayagüez:

1. F. L. Stevens, Dean—1912–14.
2. A. Fredholm, Prof. of Plant Pathology—1915–20.
3. C. M. Tucker, Prof. of Plant Pathology—1920–23.
4. B. A. Bourne, Prof. of Plant Pathology—1923.

Insular Experiment Station (Formerly Sugar Growers' Experiment Station) at Río Piedras:

1. J. R. Johnston, Plant Pathologist—1910–14.
2. John A. Stevenson (with R. C. Rose, J. R. Johnson and J. Matz, Assistants)—1913–18.
3. J. Matz (with B. López, Assistant)—1918–23.
4. F. S. Earle, Expert in cane diseases[3]—1919–21.
5. C. E. Chardón, Special Plant Pathologist for the study of sugar cane mosaic—1921–22.
6. C. E. Chardón, Expert on cane diseases—1922–23.
7. Melville T. Cook (with R. A. Toro, Assistant)—1923.

In 1918, Stevenson published his ''Check List of Porto Rican

[1] Sintenis, P. Pilzen auf der insel Portorico 1884–1887 gesammelten. In Engler. Bot. Jahrb. 17: 489–501 (1893).

[2] Heller, A. A.—Some Porto Ricna Fungi. In Muhlernbergia. 1: 18–19 (1900).

[3] F. S. Earle had served from 1918–1919 as special agent from the U. S. Department of Agriculture for the study of sugar-cane diseases.

Fungi and a Host Index," which is very complete and valuable. He cited 105 publications which are of more or less importance in the study of the fungi and plant diseases of Porto Rico. Since the publication of this work, twenty seven additional papers have been published as follows:[1]

(1) Stevens, F. L.—Some meliolicolous parasites and commensals from Porto Rico, Bot. Gaz. 65: 227–249, pl. V–VI fig. 1–5, (March 1918).

(2) Fink, Bruce.—The distribution of fungi in Porto Rico, Myc. 5: 58–61, (March 1918).

(3) Burt, E. A.—Corticiums causing Pelicularia disease of the coffee plant, Hypochnose of Pomaceous fruits and Rhyzoctonia diseases, Annals of Mo. Bot. Garden 5: 119–132, (April 1918).

(4) Fitzpatrick, H. M.—Rostronitschkia, a new genus of Pyrenomycetes Myc. 11: 163–167, pl. II, (July 1919).

(5) Stevens, F. L. and Dalbey, Nora.—Some Phyllachoras from Porto Rico Bot. Gaz. 68: 54–59, pl. IV–VIII, (July 1919).

(6) Stevens, F. L.—Dothidiaceous and other Porto Rican fungi, Bot. Gaz. 69: 248–257, pl. XLII–XIV, (March 1920).

(7) Seaver, F. J.—Notes on North American Hypocreales—IV Aschersonia and Hypocrella, Myc. 12: 93–97, pl. 6, (March 1920).

(8) Fitzpatrick, H. M.—Monograph of the Coryneliaceae, Myc. 12: 206–237, pl. 12–18 (July 1920), and Myc. 12: 237–267, (September 1920).

(9) Chardón, C. E.—A list of the Pyrenomycetes of Porto Rico collected by H. H. Whetzel and E. W. Olive, Myc. 12: 316–321, (November 1920).
———.—A contribution to our knowledge of the Pyrenomycetes of Porto Rico, Myc. 13: 279–300, fig. 1–4, pl. 13–15, (November 1921).

(10) Matz, Julius.—The Rhizoctonias of Porto Rico, Journal of the Department of Agriculture and Labor, 5: 5–30, fig. 1–28, (January 1921).

(11) ———.—Enfermedad de la raíz de la caña de azúcar, Rev. de Agricultura de Puerto Rico. 2: 39–59. 1919.

(12) ———.—Algunas observaciones respecto a la sarna del citro en Puerto Rico, Rev. de Agricultura de Puerto Rico. 2: 40–41. 1919.

(13) ———.—Citrus spots and blemishes, Circ. 16, Ins. Experiment Station.

(14) ———.—Citrus and Pineapple fruit rots, Bul. 24. Ins. Exp. Sta.

(15) ———.—La enfermedad de la raíz del café, Circ. 32. Ins. Exp. Sta.

(16) ———.—Una enfermedad dañina de las habichuelas, Circ. 57. Ins. Exp. Sta.

(17) ———.—Salcocho de los semilleros de tabaco, Circ. 55. Ins. Exp. Sta.

(18) ———.—Various papers of the Investigations of sugar-cane diseases in Porto Rico, Journal of the Department of Agriculture and Labor, 6: 5–47. (July 1922).

(19) ———.—La gomosis de la caña de azúcar, Circ. 20. Ins. Exp. Sta.

(20) ———.—Infection and nature of the yellow-stripe disease of cane (Mosaic, Mottling, etc.). Journal of the Department of Agriculture and Labor of Porto Rico, 3: 65–82 (1919).

(21) ———.—Investigations of root diseases of sugar cane. Journal of the Department of Agriculture and Labor of Porto Rico, 4: 28–[illegible] (1920).

(22) ———.—A new vascular organism in sugar cane. Journal of the Department of Agriculture and Labor of Porto Rico, 4: 41–46 (1920).

[1] This list does not include papers published in the "*Revista de Agricultura de Puerto Rico*" or trade journals

(23) ———.—The Gumming disease of sugar cane. Memoirs of the Association of Sugar Technologists, 1: 18–21 (June 1922).
(24) Stevenson, John A.—The mottling or yellow stripe disease of sugar cane. Journ. of the Department of Agriculture and Labor of Porto Rico, 3: 3–76 (July 1919).
(25) ———.—An epiphytotic of cane disease in Porto Rico. Phytopathology 7: 418–425.
(26) Figueroa, C. A.—The mottling disease of cane and the sugar production of Porto Rico. Journal of the Department of Agriculture and Labor of Porto Rico, 3: 35–41 (1919).
(27) Colón, E. D.—The absorption spectrum of the chlorophyll in yellow-stripe sugar cane. Journ. of the Department of Agriculture and Labor of Porto Rico, 3: 43–46 (1919).
(28) López Domínguez, F. A.—Has yellow stripe or mottling disease any effect on the sugar content of cane juice. Journ. of the Department of Agriculture and Labor of Porto Rico, 3: 47–64.
(29) Smyth, E. Graywood.—Insects and mottling disease. Journ. of the Department of Agriculture and Labor of Porto Rico, 3: 83–117 (1919).
(30) Chardón, C. E., y Veve, R. A.—The Transmission of Cane Mosaic. The role of Aphis Maidis in Spreading the disease under field conditions in Porto Rico. Memoirs of the Assoc. of Sugar Techn. of P. R. 1: 9–12, June 1922. Also in Phytop 1: 24–29. 1923.
(31) Earle, F. S.—El mosaico de la caña o matizado, Circ. 22. Ins. Exp. Sta.
(32) Earle, F. S.—The year's experience with sugar cane mosaic or yellow-stripe disease, Journal of the Department of Agriculture and Labor. 3: 3–150. Oct. 1919.
(33) ———.—Sugar cane root disease, Journal of the Department of Agriculture and Labor, 4: 3–27 (1920).
(34) ———.—Eradication as a means of control in sugar cane mosaic or yellow stripe, Bul. 22. Ins. Exp. Sta.
(35) Stevens, F. L., and Dalby, Nora A.—A Parasite of the tree fern (Cyathea) Bot. Gaz. 68: 222–225, Sept. 1919.
(36) Tehon, L. R.—Studies of some Porto Rican fungi, Bot. Gaz. 67: 501–511, pl. 18, (1919).

One hundred and thirty nine publications within the past twenty-five years deal more or less directly with the mycology and plant pathology of Porto Rico and nearly all of them are the results of studies made on the Island or of material recently collected on the Island. However, it is very doubtful if anything more than a beginning has been made in the taxonomic study of the fungi of Porto Rico. The study of the life history of fungi presents an extremely fascinating field which can be pursued both in an out of the laboratory for the entire year. In fact these studies must be pursued continuously for long periods of time if the best results are to be obtained. For although the climatic variations are comparatively slight throughout the year, many of the fungi have periodic seasons of growth and then disappear. The more intensive study of the fungi which attack both the indigenous and introduced

wild vegetation will not only add to our knowledge of the mycology of the Island but will no doubt give great aid to the study of the diseases of the Island crops. The diseases of our crops are causing heavy losses which are as yet not fully appreciated but which must be checked if our agriculture is to reach its highest development. The disease which has attracted the greatest attention of the public during the past few years is the mosaic of the sugar cane. This disease was first reported in Porto Rico in 1915 and has been and is at this time the cause of very heavy losses. It is without doubt the most important plant disease on the Island and has done more than any other agency to attract the attention of the public to the very great importance of plant diseases. Many people appreciate the enormous losses resulting from this disease while many others are blind to its ravages. The masterly work of Prof. F. S. Earle has demonstrated that this disease can be controlled economically. However, many do not appear to appreciate his methods and a campaign of education must be conducted before our losses from this cause will be greatly reduced. Furthermore, the cause of mosaic remains a problem for future study. The root-rot problems of the sugar cane are practically untouched, although secondary in importance only to the mosaic. The gummosis of the sugar cane is another important problem which is not fully solved. Although tobacco diseases have been studied in many parts of the world, very little attention has been given to them in Porto Rico. The coffee diseases have been the subjects of excellent studies from the Agricultural Experiment Station at Mayagüez, but much work remains to be done The general appearance of our citrus fruits shows that much remains to be done in the control of diseases before we can put the maximum amount of the highest grade fruit on the northern markets. That our knowledge of pineapple disease is very imperfect is evident to any one who has made a careful examination of the literature. It is very evident that the maximum agricultural production on the Island depends in a great measure on our knowledge of and our ability to control the many diseases of plants which are due to fungi, bacteria and other causes. The easy problems have been solved; many of the problems of the future will require the most careful laboratory technique and most thorough field technology in various lines of agriculture.

The writer wishes to express his thanks to Dr. O. L. Fassig and Mr. Geo. V. Sager of the U. S. Weather Bureau Office in San Juan for the maps and for data on temperature and rainfall.

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By

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CHIEF ENTOMOLOGIST.

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THE FOOD OF PORTO RICAN LIZARDS

By GEORGE N. WOLCOTT, Chief Entomologist

Of the factors which most vitally affect the abundance of injurious insects are the organisms which destroy them. Insects suffer enormous losses due to diseases caused by fungi and bacteria and "The Entomogenous Fungi of Porto Rico" (1) were among the first subjects investigated at the Insular Experiment Station. The insects which are parasitic or predaceous on injurious insects have been studied and reported, usually in publications dealing with the specific injurious insect, altho in one instance, "El Cucubano," (2) the beneficial insect itself is discussed. The food of the "Birds of Porto Rico" (3) was studied by Mr. Alex Wetmore and the results published in an extensive paper that is a mine of useful information. But of the two publications dealing with the food of lizards, one (4) is based largely on field observations, and partly on suppositions and deductions which in some cases prove to be erroneous, the other (5) is written from the standpoint of the herpetologist and the identifications of the insects are generalized and in only one case even generic. It is the purpose of the present paper to discuss the food of lizards from the standpoint of the economic entomologist, or in a broader sense, of the agriculturist, basing the discussion on a rather considerable number of examinations of the stomach contents of the commoner species of lizards, and, so far as possible, on the specific identification of the insects there found.

As to which of these factors—the fungi and bacteria, the predaceous and parasitic insects, the birds or the lizards—has the greater influence on the destructive insects, little can be said in general terms. The fungi are possibly of greatest importance in the citrus groves, where several species attack the scale insects, and under favorable conditions of humidity, may so far control them that the scales cease to be pests that need to be artificially destroyed. Other kinds of fungi attack white grubs, and the caterpillars of the moth stalk borer of sugar cane, but the climatic and other con-

ditions necessary for their development are so seldom realized that practically they are of little value.

The larva of the cucubano, *Pyrophorus luminosus* Illiger, is a most important ally of the agriculturist because of the large number of white grubs and other soil-inhabiting insects which it eats. No other predaceous insect even approaches it in value in destroying white grubs, but unfortunately, its benefits, as well as those of the Tachinid fly parasites, *Cryptomeigenia aurifacies* Walton and *Eutrixoides jonesii* Walton, of the adult beetles, are largely confined to the moister parts of the Island. The *cucubano* larva attacks other soil- and root-inhabiting grubs; it has been found in the tunnel of the moth borer in the butt of a stalk of sugar cane, where it had destroyed the caterpillar; and, in captivity, it has even attacked the *changa*. No insect parasites of the *changa*, or of such destructive beetles as the common weevil root-borer or "vaquita," *Diaprepes spengleri* Linn., or the banana root-borer, *Cosmopolites sordidus* Germar, have been found, and possibly this may in part explain their destructiveness.

The ubiquitous and minute egg parasite, *Trichogramma minutum* Riley, attacks the eggs of many moths and butterflies, and is possibly of greatest importance as a parasite of the moth stalk-borer of sugar cane, *Diatraea saccharalis* Fabr., because this caterpillar is so seldom parasitized or destroyed by other means. Some of the other destructive caterpillars, such as the common cane caterpillar or grassworm, *Laphygma frugiperda* S. & A., the cane looper, *Mocis repanda* Fabr., and the cotton caterpillar, *Alabama argillacea* Hübner, have a host of Tachinid and Hymenopterous parasites, but due to the unstable equilibrium between host and parasites, these pests sometimes occur in enormous abundance and do much damage before their parasites become sufficiently abundant to eliminate them. Other caterpillars, especially those feeding on tobacco, are rather rarely parasitized, and for the control of these, artificial methods must often be adopted.

Birds are a most important factor in the destruction of insects. The comparatively large size of the individual bird, its high body temperature and the active life which it leads require that it consume an enormous amount of food. Translated into terms of insects, to quote from Wetmore: "One stomach (of the blackbird or *mozambique*) contained 16 cutworms, as well as 3 adult cane root-boring weevils, *Diaprepes spengleri* Linn." "Remains of 11 (of these weevils) were taken from the gizzard and from 3 to 6 were

not unusual." "Two birds had eaten cattle ticks, *Margaropus annulatus* . . . one, ... 35 ticks, the other 12 ticks, all greatly distended with blood." And these figures represent only one meal of the blackbird, not all the food that one bird eats during one day.

But as effective as some insectivorous birds may be in destroying insects, in Porto Rico their influence is minimized by their comparative rarity, especially in comparison with the number of lizards occupying the same area. To be sure, the lizards average smaller than the birds, but what the individual lizard lacks in size is much more than counterbalanced by their enormous numbers. Laboratory experiments with lizards to determine how much they eat, for comparison with how much birds eat, have not been very successful, and because lizards are not warm-blooded, nor as active as birds, they presumably eat considerably less than do birds of comparable size. But their extraordinary abundance makes them one of the major factors in reducing the numbers of insects.

The only way of determining with certainty the food of a wild animal is by dissection and examination of the stomach contents. In making such determinations, certain points should be observed. (1) The animals collected should be obtained at an appropriate time of day so that one may be reasonably sure that they have fed recently. (2) A sufficient number should, if possible, be examined to give a fair average, and largely minimize some abnormal element of food which might otherwise be given undue prominence. (3) In temperate countries, where there is a sharply defined seasonal succession of foods available for many animals, the examinations should be made at all seasons of the year. In Porto Rico, only a few insects have even well-defined periods of seasonal abundance, and the resulting variations in what the lizards eat are consequently quite minor. (4) The variations due to the various environments under which individuals of the same species of lizard may live may exert a much greater effect, and this proved to be the case in the present investigation. About half of the lizards were collected at Río Piedras but under as widely varying conditions of environment as possible, and the remainder from other parts of the Island. The composite data thus obtained, will, it is hoped, at least in the case of the commoner and consequently more important species, present an accurate picture of what the lizards eat.

To properly value the benefits of the agricultural interests of the Island derived from the insectivorous habits of the lizards, a specific identification of the elements of their food is often most

essential. Anything less than this may prove valueless from the standpoint of the agriculturist, because the vital point is whether the insect eaten is beneficial or injurious. However, the classification into beneficial, neutral and injurious forms is by no means so simple as might at first appear.

For instance: the kingbird in the United States has the reputation of being a serious enemy of honey-bees, but when a careful examination was made of the bees that these birds had eaten, it was found that most of them were drones and only a very few were workers.

In Porto Rico the cane caterpillar and grassworm, *Laphygma frugiperda* S. & A., feeds on the leaves of sugar cane and grasses, and is very destructive in cane fields and low pastures, but it also eats grasses which are weeds in cane fields and those of other cultivated crops, and it is to this exent beneficial. The caterpillar of *Xylomiges eridania* Cramer feeds on "bledo" or *Amaranthus* spp. and wild eggplant, both common weeds, but it is just as likely to feed on the leaves of cultivated eggplant or tomatoes, and be a serious pest. The little Chrysomelid beetle, *Chaetocnema apricaria* Suffrian, feeds on the leaves of sweet-potato, and if one found specimens in the stomach of a lizard collected in a sweet-potato patch, there would be no question about stating that the lizard was beneficial to the extent of having destroyed an injurious beetle. But the beetle also feeds not only on the leaves of the mangrove and other lagoon-margin trees, but also on the leaves of the wild morning glory, which is a most persistent weed.

In the following discussion, the insects which may be, and for the most part are injurious, are grouped with those which are invariably injurious. Also, because in many cases, the caterpillars could not be specifically identified (altho often to genus and almost always to family) they are listed as injurious, even tho it is realized that they may be beneficial. Considered from another point of view, however, this is not entirely unjustifiable. It is even an underestimate of the number of caterpillars which the lizard might eat if there were a destructive outbreak of some injurious species. And this is not merely a suposition. The caterpillars of *Mocis repanda* Fabr., the cane and grass looper, were very abundant generally in Porto Rico during the late fall and early winter of 1923, and were so abundant in many restricted areas as to entirely destroy the cane or grass growing there. One cane grower claimed they were so abundant in a field near his house that he could hear

the noise of their jaws at night. In the months before and after the exceptional abundance of *Mocis repanda,* a rather small percentage of many other different kinds of caterpillars was found in the stomachs of the lizards examined, but during the months of the abundance of *Mocis repanda,* the percentage of caterpillars eaten more than double and practically all were of this one injurious species.

Because lizards (and birds) do, within limits, vary their diet depending upon what food is to be had, thus making their services in checking an outbreak of a destructive insect more immediately available, their value is correspondingly greater than that of parasitic insects, which are usually much more restricted as to their host. Even if under ordinary circumstances a considerable portion of the food of lizards consists of insects neutral in their relation to man, or even those that on occasion are positively beneficial, these insects can well be spared. They serve to maintain a much larger force of lizards available for immediate use in checking the outbreak of destructive insects than could otherwise exist were they forced to depend entirely on injurious insects for their food.

To partly offset this admittedly artificial grouping of all caterpillars as injurious, is the placing of all predaceous and parasitic insects as beneficial. Not all are, or rather, not all are all of the time, altho most are much of the time. They are beneficial to the extent that they prey upon destructive insects, and injurious to the extent that they destroy beneficial insects. But one can never hope to accurately determine these proportions. And as the lizards eat the injurious insects themselves in so much larger quantities than they do the parasitic and predaceous insects and spiders, the relatively small element in their food of possibly beneficial insects should not be too harshly judged.

Nineteen species of lizards have been listed as occurring in Porto Rico (6) but some are quite rare and are correspondingly unimportant economically. When individuals of any of the rarer species have been collected, the observations made on their food are here recorded, but this is quite incidental to the main investigation on the food of the commoner species.

To Mr. Francisco Seín, Jr., Assistant in the Department of Entomology, I am much indebted for aid in the collection of material, as practically all of the lizards of the genus Anolis were caught by him. The peon assistant in the laboratory, Andrés To-

rres y Ríos, caught most of the *Ameiva*. For killing the lizards, carbon bisulfid was found most satisfactory in rapidity of action, and was administered in a large bottle with cotton in the bottom. Dissections were usually made immediately, altho sometimes postponed till the following day, but the contents of the stomachs were often placed in alcohol for later examination.

The largest common lizard *Ameiva exsul* Cope in Porto Rico is the "iguana" or ground lizard. It is most often noted running swiftly along the ground near the coast or in river valleys, but sometimes occurs in hills of no great elevation. Around Río Piedras it is quite common, but runs so rapidly and remains in its burrow for such a large part of the day that specimens are captured with difficulty.

Two batches of eggs, four in one and seven in another, were found buried at a depth of four or five inches in a pile of humus in the garden at the Station. Four that were not broken measured:

22 mm. × 15.5 mm.	—faintly pink in color
21 mm. × 13 mm.	bright pink in color
20.5 mm. × 13.5 mm.	
20 mm. × 13 mm.	

From one egg a lizard hatched and was kept for a considerable time in captivity. During the first few days he ate no food, but drank large amounts of water. Later, he daily ate one quite large insect about noon. He lived quite happily in a tobacco can horizontally buried in the soil, and would often cover the entrance to his burrow with earth while he was inside. Ordinarily he did not appear above ground till 11 a. m., or later, often retreating to his burrow several times before eating, and always retiring soon after his meal, not to appear again till the next midday. Later, as he grew older, and especially if his container were placed in the sunlight, he might appear above ground earlier in the day, sometimes by 9 a. m. or 8:30. He was fed large cockroach nymphs, 2nd- and 3rd-instar white grubs, *Lachnosterna portoricensis* Smyth, silkworm caterpillars and moths, and half-grown tobacco hornworm caterpillars, *Protoparce sexta* Joh.

The normal habits of the *iguana* do not differ greatly from the one kept in captivity, except that ordinarily the entrances to their tunnels are not filled with earth. Obtaining food only during the middle of the day is undoubtedly characteristic of this species, as the stomachs of all specimens caught at Río Piedras during the

winter in the forenoon were empty, while those of the early afternoon were always full. Only fifteen lizards that had recently eaten were examined: one small one from near the beach west of Arecibo, five from near the beach between the Condado and Pt. Cangrejos and the remainder from the garden, pastures or cane fields around Río Piedras. Because the records are so interesting, they are given in detail, the percent eaten by each individual being noted after the food, followed in parenthesis by the number of insects or other objects in the stomach and the point of collection.

DETAILED RECORD OF THE FOOD OF 15 *Ameiva exsul* Cope

Agaric mushroom 100% (1 Río Piedras)
Earthworm 45% (1 Río Piedras)
Snails 8% (1 Río Piedras), 20% (1 Río Piedras)
Millipede 2% (1 Río Piedras)
Sand Fleas 65% (50—more or less—Pt. Cangrejos)
Large sawbug-like Crustacean 15% (1 Pt. Cangrejos)
Attid spiders 15% (3 Pt. Cangrejos), 4% (1 Arecibo)
Earwig 1% (1 Río Piedras)
Cockroaches:
- *Periplaneta americana* Linn. 20% (1 Río Piedras), 50% (1 R. P.)
- *Epilampra wheeleri* Rehn 30% (1 Río Piedras)
- Very small nymph 5% (1 Río Piedras)

Grasshoppers:
- *Plectrotettix gregarius* Sausurre 15% (1 Pt. Cangrejos)
- *Schistocerca columbina* Thunberg 70% (1 Pt. Cangrejos)

Crickets:
- *Ellipes minuta* Scudder 10% (2 Arecibo)
- *Amphiacusta caraibea* Sausurre 10% (1 Pt. Cangrejos), 20% (1 Pt. Cangrejos)

Hymenoptera:
- *Solenopsis geminata* Fabr. 1% (1 Arecibo)
- black bee 10% (leg and mouth parts only, Pt. Cangrejos)

Coleoptera, beetles or their larvae:
- Histerid beetles 40% (4 Pt. Cangrejos)
- *Hymenorus* sp. 10% and 3% (2 Pt. Cangrejos)
- *Zophobas* sp. (determined by Mr. St. George), 10% (1 larva Río P.)
- *Monocrepidus bifoveatus* P. B. 15% (1 Pt. Cangrejos), 2% (1 larva at Pt. Cangrejos), 30% (1 Arecibo)
- *Lachnosterna portoricensis* Smyth 60% (3 larvae at Río Piedras), 2% (2 eggs at Río Piedras)
- *Cryptocephalus* sp. 5% (1 Arecibo)

Lepidoptera:
- Arctiid caterpillar 5% (1 Río Piedras)
- Noctuid caterpillars 15% (1 Pt. Cangrejos)
  - 15% (1 Pt. Cangrejos)
  - 20% (1 Río Piedras)
  - 30% (8 Río Piedras)
  - 100% (2 Río Piedras)
  - 38% (8 Río Piedras)
  - 30% (1 Río Piedras)
  - 60% (1 *Laphygma frugiperda* S. & A.)
  - 20% (1 Río Piedras)
- Noctuid pupa 10% (1 Río Piedras), 2% (1 Río Piedras)
- Noctuid moth 30% (1 Río Piedras)
- Pyralid caterpillars 20% (4 Arecibo)
  - 12% (3 Río Piedras)
  - 80% (10 Río Piedras)
  - 30% (1 Río Piedras)

Diptera:
- Sarcophagid maggots (determined by Mr. Greene) 100% (50 more or less, at the Condado—from carrion)
- Asilid flies, Proctacanthus rufiventris Macq., 25% (1 Pt. Cangrejos), 5% (legs only, from Pt. Cangrejos)

Hemiptera:
- Pentatomid bug, *Arvelius albopunctatus* P. B., 15% (1 Pt. Cangrejos)
- Cydnidid bug, *Rhytidiporus indentatus* Uhler, 20% (1 Pt. Cangrejos)

Homoptera:
- leafhoppers, *Draeculacephala sagittifera* Uhler, 30% (6 Arecibo)
- Fulgorids, *Ormenis marginata* Brunnich 20% (1 Pt. Cangrejos), & 5% (1 nymph)
- Ground pearls, *Margarodes formicarium* Guilding 3% (1 Pt. Cangrejos), 2% (1 Pt. Cangrejos)

Lizard eggs: 20% (2 Río Piedras), 60% (1 Río Piedras)

SUMMARY

Mushrooms 6.7%	Orthoptera 15%
Earthworms 3%	Hymenoptera 1%
Snails 2%	Coleoptera 12%
Millipede .1%	Lepidoptera 34.5%
Sand Fleas 4.3%	Diptera 8.7%
Sowbugs 1%	Hemi-Homoptera 6.3%
Spiders 1,3%	Lizard eggs 5.3%

The only elements in the food of these fifteen specimes that can be considered as in any way beneficial are the spiders, the earwig,

possibly the Asilid flies, and the lizard eggs, which altogether total only 8.7 per cent.

Altho no *changa* happened to occur in the stomachs of any of the *iguanas* examined, the readiness with which other Orthoptera are eaten would indicate that the absence of the *changa* is due merely to the accidents of collection, in that not sufficient specimen were examined. The point most especially to be noted is that three white grubs had been eaten by one *iguana,* and two *Lachnosterna* eggs by another. These may have been obtained from a field being plowed, but none were near where these specimens were collected, and presumably these grubs and eggs were obtained by burrowing. The large number of caterpillars (or pupae or moths)—46, some of which could be positively identified as injurious species, eaten by 15 *iguanas*—and constituting over a third of the total food, needs no comment.

The *iguana,* because of its burrowing habits and consequent ability to obtain white grubs and presumably other soil-inhabiting grubs for food, because of its large size and consequent ability to eat large insects, or large numbers of smaller ones, and because it eats so few insects which can possibly be considered beneficial, and so many that are injurious, is undoubtedly one of the most valuable wild animals in Porto Rico.

Mabuya sloanii Daudin

The "skink," altho having a rather wide distribution in the West Indies, is rare in Porto Rico. During the course of the investigation, only two were observed, a pair in the valley of the Río Loco near Yauco. One was with difficulty captured by Mr. Seín, and found to have eaten one large cricket nymph, *Grillus assimilis* Fabricius.

Hemidactylus mabouia Moreau de Jonnes

All the geckos observed were light yellow in color with black eyes, and altho somewhat clumsy in appearance, proved surprisingly agile in eluding capture. All noted appeared at night on the ceiling of houses, around electric lights, where they caught the insects attracted to the lights.

Sphaerodactylus macrolepis Gunther

The "salamanquita" or Santa Lucía is moderately abundant in the soil or under piles of cane trash, but none were dissected for

stomach examinations. All collected had been kept alive in captivity a day or more before being brought to the laboratory, and upon being released one established headquarters there, being several times found under botanical specimens.

Anolis cuvieri Merrem

Most of the lizards found in Porto Rico belong to the genus *Anolis*, and of these possibly the rarest and certainly the largest is the giant green lizard, *Anolis cuvieri*. Only one specimen was collected, from a ceiba tree in the Ciales valley about 6 kilometers south of Manatí, and it had eaten four quite large snails. Dr. B. H. Ranson, of the Bureau of Animal Industry of the U. S. Department of Agriculture, identified a fluke found in the stomach with the snail remains as a "mature distome fluke, presumably a normal parasite of *Anolis cuvieri*."

Anolis evermanni Stejneger

Anolis evermanni Stejneger is a green lizard, found only in Porto Rico, that is common only in the higher mountains. It was not found in the mountains south of Ciales at kilometer 30, but a single specimen was collected at Jajome Alto between Cayey and Guayama, and the remaining nine specimens were collected on El Yunque, above Santa Catalina (the type locality) but still within the coffee grove. Most of the insects eaten are pests of, or occur on, coffee trees and *Inga vera*.

Only one lizard had eaten spiders, and another had eaten a snail, but these were the only elements of food which were not insects, and they totaled only 1 per cent.

One lizard had eaten a winged termite, another four springtails, a third an undetermined Psocid.

Three lizards had eaten "hormiguilla," *Myrmelachista ambigua ramulorum* Wheeler, and this ant constituted 3 per cent of the total food. The "albayalde," *Wasmannia auropunctata* Roger, had been eaten by two lizards, and *Tapinoma melanocephalum* Fabricius by one, which, together with the unidentified ant fragments, brought the total for ants up to 5.4 per cent. Two small wasps, possibly *Tetrastichus* sp., had also been eaten.

Beetles constituted almost half (41.4 per cent) of the total food, but nearly half (20 per cent) were beneficial Lampyrids, *Callopisma borencona* L. & M., *Lucidiota decorus* G. & H., and *Photinus dubiosus* L. & M., being identified. The other beetles were: *Monocrepidus*

bifoveatus P. de Beauvois—the tobacco wireworm, *Cryptocephalus nigrocinctus* Suffrian, a small red and black Cerambycid beetle (unidentified), and 32 individuals of *Platypus ratzeburgi* Chapuis which has repeatedly been observed boring in the trunks of *Inga vera.*

Caterpillars and moths constituted 11 per cent of the food of the lizards examined, one large Noctuid moth being four-fifths of what one lizard had eaten.

Bibionid and Agromyzid flies constituted only half of one per cent of the food, and two unidentified Hemiptera were less than one per cent. Strange and for the most part undescribed Fulgorids constituted over a quarter of the food (26.8 per cent). These Fulgorids were mostly mottled with grey and brown and live on the bark of trees.

Of the leafhoppers, four *Xestocephalus pulicarius* Van Duzee, which is sometimes found on the tender shoots of coffee, and two Deltocephalus sp. had been eaten. Twelve of the *Inga vera* Psyllids, *Psylla municoma* Crawford, had been eaten by three lizards and constituted 5.3 percent of the total food, and brought the total for Homptera up to 37.6 per cent.

No vegetable food had been eaten by any of the ten lizards examined.

SUMMARY

Beetles and bugs constitute four-fifths of the food of the green lizard of the mountains, and ants and moths and caterpillars most of the remainder. Unfortunately, nearly half of the beetles eaten are predaceous and presumably beneficial. But all of the other beetles eaten are more or less injurious, and the one of which greatest numbers were eaten is a serious pest of *Inga vera.* The psyllids which feed on the leaves of *Inga vera* are commonly eaten, as well as leafhoppers of coffee, and the ants "hormiguilla" and "albayalde" which are pests on both kinds of trees.

Anolis pulchellus Dumeril & Bibron

Anolis pulchellus is the small greenish-brown lizard with the yellow sides which is so common in Porto Rican grasslands and canefields. It is possibly the most abundant species occurring in the Island and certainly is most important economically because of the large number of the smaller insect pests of sugar cane and forage grasses which it destroys.

Fifty lizards of this species were collected at Río Piedras in September and October, in upland meadows and pastures, and from cane fields.

Three small snails had been eaten by these lizards, and two were still alive when removed from their stomachs. Eight sowbugs had been eaten by four lizards, a millipede had been eaten by another and small centipedes by two others. The spiders were a considerable item of food, forty-two having been eaten by half the lizards and constituting nearly 4 per cent of all food. Most of the spiders were small Araenids, but several quite large Attids were also eaten. Forty small mites determined by Dr. Ewing as Lohmannia sp. had been eaten by six lizards, and in two cases formed a third of the food. The total amount of invertebrate food other than insects amounted to nearly 8 per cent.

Two small cockroaches, two earwigs and one small changa, *Scapteriscus vicinus* Scudder, had been eaten by as many lizards and formed from 10 per cent to 20 per cent of the food in each case. One Damsel fly, *Enallagma* sp. (Odonata), had been eaten by one lizard and occupied nearly half his stomach.

Ants constituted one-fifth of the food eaten. The species varied in size from *Odontomachus haematodes* Linnaeus to *Tapinoma melanocephalum* Fabricius, and altho soldiers and winged adults were most often eaten, the smaller workers were not overlooked. Twelve individuals of *Odontomachus* were eaten, and constituted a quarter of the food of the six lizards that ate them, as did also the soldiers and workers of *Pheidole fallax jelskii antillensis* Forel, of which 34 were eaten. Nine "hormiga brava", *Solenopsis geminata* Fabricius, were eaten and 28 "albayalde", *Wasmannia auropunctata* Roger. The two species of *Tapinoma melanocephalum* Fabricius and *littorale* Wheeler, were also found in considerable numbers, as well as:

Anochetus mayri Emery	1 %
Monomorium pharaonis Linnaeus	1.5%
M. ebeninum Forel	.1%
Cardiocondyla emeryi Forel	.3%
C. venustula Wheeler	.2%
Tetramatorium simillimum F. Smith	.8%
Atta smithi borinquensis Wheeler	.1%
Cyphomyrmex rimosus minutus Mayr	.2%
Iridomyrmex melleus Wheeler	
Brachymyrmex heeri Forel	.4%
Prenolepis longicornis Latreille	

Two lizards had eaten *Apanteles* wasps, one a small yellow and black Chalcid and three *Eurytoma* sp. (?) wasps, but the *Hymenoptera*, aside from the ants, amounted to only 1 per cent of the total food eaten.

The beetles constituted nearly 5 per cent of the total food, and abount a sixth of the food of the lizards that ate them. None of the beetles were large; but *Cerotoma denticornis* Fabricius, the leaf beetle; *Epitrix cucumeris* Harris, a tobacco flea-beetle; and *Cylas formicarius* Fabricius, the "piche" of sweet potatoes, one of each of which had been eaten, are important economic pests. The other beetles were identified as *Phaenonotum estriatum* Say, *Aphodius granarius* Linaeus, *Loberus testaceus* Reitter, *Xantolinus* sp. (7 eaten) and *Stephanoderes* or *Xyleborus* sp. (7 eaten).

Lepidoptera constituted over a fifth of the food. Twenty-five moths had been eaten by fourteen lizards and averaged over half of their food. None were in such shape that they could be specifically identified, but several Noctuids, many Crambids and a number of Acrolophids were noted, altho most were small Micros. Twenty-one caterpillars had been eaten by fifteen lizards and averaged over a quarter of their food. One *Laphygma frugiperda* S. & A. was identified and many of the others were Crambids, probably in some cases *Diatraea saccharalis* Fabr.

Minute flies of the families Mycetophylidae, Bibionidae, and Agronomyzidae were eaten by more than half the lizards, and in large numbers by some of them, often forming a third or a fourth of their food. One hundred thirty individual flies had been eaten and constituted over an eighth of the total food.

Twenty-four thrips of various species had been eaten by ten lizards, but because of the small size of the individuals, they formed an insignificant fraction of the food.

Forty chinch bugs, *Blissus leucopterus* Say, had been eaten by eighteen lizards, and constituted a quarter of their food. It appears quite possible that the main reason why the chinch bug is practically unknown as a pest of corn, rice and sugar-cane in Porto Rico is because it forms such an important item of food for lizards. Its size, comparatively slow movements and high visibility render it especially well adapted to be eaten by lizards of grass and low vegetation. The only records of the chinch bug being common enough to become a pest are in the plantations of guinea grass of the northwest coast, especially around Hatillo.

Together with another Lygaeid bug, *Orthaea bilobata* Say, and a Capsid, the chinch bugs constituted over one-tenth of the total food.

The leafhoppers formed one-fifteenth of the total food, the species identified being:

5	*Kolla similis* Walker	1.6 %
21	*Kolla fuscolineella* Fowler	1.5 %
11	*Xestocephalus pulicarius* Van Duzee	1.2 %
7	*Deltocephalus flavicosta* Stal	1.5 %
3	*Chlorotettix* sp.	.3 %
2	*Eugnathodus bisinuatus* DeLong	.14%
2	*Protalebra brasiliensis* Baker	.3 %

Twenty-one individuals of *Kolla fuscolineella,* thirteen adults and eight nymphs had been eaten by one lizard and were three-fourths of what it had eaten. *Kolla similis* is by far the most abundant leafhopper on *malojillo* and other grasses in Porto Rico during wet weather, or growing on low ground but is quite scarce on the upland meadows where most of the lizards were collected. *Xestocephalus pulicarius* is also thought to be quite rare, but eleven individuals had been eaten by ten lizards.

The fulgorid, Oliarus cinereus Wolcott, altho common and readily seen, is quick and wary, but, together with unidentified species of *Liburnia,* it constituted over 5 per cent of the total food. Eleven lizards had eaten seventeen individuals of *Oliarus;* often it was a fourth or a fifth of all they had eaten.

Unidentified Psyllids amounted to 1.5 per cent of the total food, nineteen individuals having been eaten by seven lizards.

Fifty-eight aphids, all of which were *Aphis maidis* Fitch, the common species on *malojillo* grass, had been eaten by seven lizards, and constituted a sixth of their food. Unidentified yellow mealy-bugs were an even more important item of food, having been eaten by a quarter of the lizards and forming 2.3 per cent of all food.

One lizard had eaten the anthers from grass flowers, another an oval black seed, another a small stone, but aside from these items, all the food observed consisted of small invertebrates, mostly insects. The amount of beneficial insects eaten was negligible, while the number of chinch bugs, and corn aphids, presumably obtained from *malojillo* grass, eaten was so considerable as to be an important factor in their control, to say nothing of the occasional changa, bean-leaf beetle, tobacco fleabeetle, sweet potato weevil,

and the numerous fire ants destroyed. Most of the other insects are of slight importance to economic crops, under present conditions, but might develop into serious pests were the lizards not here to reduce their numbers.

For comparision with the data obtained at Río Piedras on the food of *Anolis pulchellus*, sixty additional lizards were collected from other parts of the Island. One was found in the swamp at Boquerón in November, three were from pastures near tobacco fields at Juncos in December, twenty-four were collected in the Ciales valley near Manatí in pastures and meadows close to the river during December, nine were from a pasture north of San Germán in March, five were from an uncultivated field at Toa Baja and eighteen were from low guinea-grass meadows in which malojillo grass had grown up in the furrows at Camuy, all collected in March.

Eight snails had been eaten and formed 1.8 per cent of all the food eaten, while only five sowbugs had been eaten and formed only .4 per cent of the food. Seven centipedes had been eaten. forming 1.5 per cent of the food. Had the spiders eaten by nearly half the lizards been divided among them all, there would have been a spider apiece. A few of the spiders were large Attids and formed a considerable portion of the food, but most of them were small Argliopoids and formed a tenth or less of the food of the lizard. They totaled 9.7 per cent of the food Only one mite, *Lohmania* sp., was eaten.

Springtails had been eaten by two lizards.

Nymphs of a small grasshopper, *Conocephalus cinereus* Thunberg, had been eaten by seven lizards and in several cases entirely filled their stomachs. They totaled 5.75 per cent of the food of all.

The 82 ants eaten by the 60 lizards formed a ninth of their food—11.2 per cent. One-third of this number were of the species *Pheidole antillensis* Forel, and formed nearly half of the bulk. The large "berraco", *Odontomachus haematodes* Linn. (or its subspecies), bulked next largest, altho only nine were eaten. 15 *Monomorium destructor* Jerdon, 12 "albayalde" *Wasmania auropunctata* Roger, 8 *Tapinoma* sp., 2 unidentified Ponerids and 2 "hormiguilla" *Myrmelachista ramulorum* Wheeler were also found. Fourteen bees and wasps, some of them of considerable size, had been eaten and formed 5.5 per cent of the total food. Three bees, *Chloralictus* sp., two *Eurytoma* sp., one *Tetrastichus* sp., one *Micro-*

bracon sp., six *Apanteles* spp. and one *Splilochalcis femoratus* Fabr., were identified, the latter being parasites of destructive caterpillars and decidedly beneficial.

Altho only a few beetles were eaten, several were of considerable size and they totaled 5.2 per cent of the food. One *Coccinellid* larva was identified, two adult Chrysomelid beetles, *Crytocephalus nigrocinctus* Suffrian; and one Otiorhynchid *Lachnopus curvipes* Fabr.

Lepidoptera constituted over a fourth of the food (26.6 per cent.) Seven moths had been eaten, nine eggs, and forty-three caterpillars. Fifteen caterpillars were definitely identified as being *Mocis (Remigia) repanda* Fabr., a common cane and grass cutworm, of which outbreaks of considerable severity occurred at many points of the Island during the winter. Most of those eaten were quite small, and the importance of having them destroyed before they had done much damage makes their consumption by this lizard all the more valuable. Two and possibly more of the other caterpillars were *Laphygma frugiperda* S. & A., and several appeared to be *Diatraea saccharalis* Fabr., both important pests of sugar cane, and one was a bagworm, *Oeceticus kirbyi* Guilding.

Forty-three flies, totaling 5.4 per cent of the food, had been eaten, most of them being small Bibionids which do not bulk very large, besides a few Mycetophilids, Agromyzids, and Tipulids. Of those more specifically identified, the largest was *Pyrellia scapulata* Bigot; three were *Toxomerus laciniosus* Loew, a common Syrphid fly in high grass; and one was *Ensina humilis* Loew, a very small Trypetid fly.

Seventeen Hemiptera had been eaten by the sixty lizards and constituted 4.65 per cent of their food. Seven individuals of the Lygaeid bug, *Orthaea bilobata* Say, had been eaten, but one noted no chinch bugs, which formed such an important element, both in bulk and economically, in the food of the lizards at Río Piedras. The outbreak of chinch bugs which had appeared during the winter in the northwestern-corner of the Island had entirely disappeared by March when the lizards were collected at Camuy. The winter rains were undoubtedly responsible for the disappearance of the chinch bugs, and not the lizards, for the latter were scarce and could be found only in low pastures where *malojillo* grass was displacing the guinea grass. On the upland pastures, where the ground was covered with grama grass and abundant shelter was

afforded by high weeds and bushes, only a very few lizards were to be found, and in the guinea-grass fields, where the bunches were spaced 18 inches or 2 feet apart so that they could be cultivated, none at all were to be seen. Presumably, it is the long periods of drought and not some other factor, certainly not lack of food, which prevents *Anolis pulchellus* from being more abundant in this district, and which also provides the proper conditions for the chinch bug to become a serious pest.

Orthaea bilobata Say is recorded from numerous hosts, but at Manatí (where nearly half of the lizards were collected) it was noted as being very abundant on the ground under a *jaguey* tree, and had been eaten by several *Anolis stratulus* collected from this tree.

Of the other Hemiptera, the following were identified: one *Alydus pallescens* Stal, one *Chariesterus moestus* Burmeister, one *Corizus sidae* Fabr., one *Corizus hyalinus* Fabr., and one *Corythaica monacha* Stal.

A common leafhopper, *Kolla similis* Walker, largely took the place of the chinch bugs which had been eaten by *Anolis pulchellus* at Río Piedras. The lizards of this species collected at Río Piedras were from the Station grounds around the laboratory, and from a hill pasture, where *Kolla similis* is rarely abundant, even during the wettest weather. This leafhopper is very sensitive to moisture and occurs most abundantly along stream or ditch margins on *malojillo* grass, extending its range only during periods of abundant rainfall. Most of the *Anolis pulchellus* collected away from Río Piedras were from low pastures along stream margins, where Kolla similis is common, and that it should form 9 per cent of the total food of the lizards is not suprising. Thirty-four leafhoppers of this species were eaten by seventeen lizards, as compared with an equal number of all other kinds (which, however, bulked only 5.75 per cent) eaten by twenty-eight lizards. Those identified were:

6 *Kolla fasciata* Walker
4 *Xestocephalus pulicarius* Van Duzee
10 *Deltocephalus flavicosta* Stal (or spp.)
4 *Thamnotettix colonus* Uhler
3 *Chlorotettix* spp.
4 *Eugnathodus bisinuatus* DeLong
3 *Protalebra brasilensis* Baker

The Fulgorids formed 6.3 per cent of the food of the sixty lizards, forty-nine having been eaten; eight being *Delphacodes teapae* Fowler, thirty-eight other species of *Delphacodes,* two *Oliarus cinereus* Wolcott and one Sogota cubanus Crawford, all being common species on grass.

One Membracid, *Monobelus, fasciatus* Fabr., six grass Psyllids (unidentified), five aphids of which two were *Aphis maidis* Fitch, three mealybugs, and one scale insect, *Saissetia nigra* Nietner from the remainder of the Homoptera eaten, amounting to 2.5 per cent of the total food.

Anolis krugii Peters

Anolis krugii, altho readily distinguished from *Anolis pulchellus* by the orange dewlap of the male and the broader head, and by the higher elevations and more shaded habitat in which it occurs, is similar in general appearance and habits. Its food is the same in general as that of *A. pulchellus,* with a few minor, but interesting, exceptions, largely due to the difference in abundance of some species of insects at the higher altitudes.

Two *Anolis krugii* were collected in a coffee grove near Maricao in November, six from a sweet potato patch near Cayey in the same month, nine from a mountain meadow near Aibonito in January and thirteen from a pasture south of Ciales in March, making a total of thirty specimens examined.

Five snails had been eaten, forming 1.6 per cent of the food. Twelve sowbugs, forming 33 per cent of the food, had been eaten by six lizards. Spiders, in a few cases Attids, but usually Agriopoids, had been eaten by almost half of the lizards and formed 6.8 per cent of the total food. One male cattle tick, *Margaropus a. australis,* as determined by Mr. F. C. Bishopp, had been eaten by one of the lizards from Cayey.

Another lizard from Cayey had eaten an earwig, *Anisolabis ambigua* Borelli, and the remains of a cricket were found in the stomach of one from Ciales. Another from Ciales had eaten a springtail.

The ants formed one sixth of the total food, but altho *Pheidole antillensis* Forel was second in bulk and numbers, unidentified Ponerine ants were most abundant. The "albayalde" *Wasmannia auropunctata* Roger and *Tapinoma* sp. were third and fourth, and two specimens of Atta (*Mycoceporus*) *smithi* Forel var. *borinque-*

nensis Wheeler had been eaten by lizards from Ciales. Five *Apanteles* wasps and two other small wasps had been eaten, but they formed only 1.3 per cent of all the insects eaten—the only beneficial insects eaten by this species of lizard, and quite over-balanced by the 88 per cent of neutral or destructive insects which it had eaten.

Beetles formed 4.5 per cent of the total food. Those identified were: one *Philhydrus* sp.; two *Chaetocnema apricaria* Suffrian eaten by a lizard at Cayey, where they had doubtless been feeding on the sweet-potato leaves; one *Photinus dubiosus* L. M. & M. and one *Apodrusus wolcotti* Marshall eaten by the lizard from Maricao —the first a firefly, the latter an Otriorhynchid which feeds on the leaves of *Inga vera.*

Lepidoptera formed a third of the total food eaten (33. per cent), which is a much larger proportion than that of any of the other small lizards, and consisted of seven moths and twenty-seven caterpillars. At least four of the latter appeared to be *Mocis repanda* Fabr. and one *Diatraea saccharalis* Fabr.

One thrips had been eaten by a lizard from Ciales.

Diptera constituted 9.4 per cent of the total food. Ten Bibionids, five Agromyzids, three small Muscids and two Tipulids (all unidentified as to genus) and one Dolichopodid, *Psilopus caudatus* Wiedemann together constituted scarcely half the bulk of the flies; one *Pyrellia scapulata* Bigot and three large maggots made up the rest.

Eight *Orthaea bilobata* Say constituted the larger portion of the Hemiptera eaten (3.4 per cent), the others being an unidentified Capsid, possibly a species of *Poeciloscytus,* and nymphs that could not even be assigned to a family.

Of the eighteen leafhoppers eaten, eleven were *Kolla fasciata* Walker and only four *Kolla similis* Walker. The former is very seldom found at the lower elevations and is mostly a leafhopper of mountain grasslands, while the latter is commonest along stream margins. One *Xestocephalus pulicarius* Van D., one *Thamnotettix colonus* Wheeler and one Protalebra brasilensis Baker had also been eaten, making a total of 8 per cent of all food consumed.

Of the nine Fulgorids, constituting 6 per cent of all food, most were species of *Delphacodes,* especially *teapae,* but a lizard from Maricao had eaten only an *Oliarus cinereus* Wolc. Eleven grass

Psyllids, two aphids and one mealybug bring the total for all the Hemiptera to 16.5 per cent.

SUMMARY

Combining all the records on *Anolis pulchellus* and *Anolis krugii*, the large number of moths and caterpillars eaten is especially noticeable. While some of these may be indirectly beneficial, in that they feed on weeds that otherwise might have to be destroyed by cultivation, yet some and possibly most the caterpillars are directly injurious. The leafhoppers and other bugs (Hemiptera-Homoptera) may not be especially injurious to cultivated crops, yet when an outbreak of the chinch bug threatens in a region where lizards are normally abundant, by a slight change in their food from the leafhoppers and other bugs, the incipient outbreak will be prevented. In the same way, even tho many of the caterpillars which the lizards feed on are normally of little importance, yet when an outbreak of grass loopers or cutworms threatens, the lizards will eat large numbers of these injurious caterpillars while they are still small and before they have done serious damage. Many of the ants eaten are injurious to agriculture, and those that are neutral will not be missed. The only elements in the food of the lizard that are beneficial are the parasitic wasps and the predaceous spiders and beetles and earwigs. But these form such a small part of the food of this lizard as compared with the major portion of its food which consists of injurious insects that it may be considered very decidedly beneficial.

Anolis stratulus Cope

Anolis stratulus is a medium-sized to small lizard, grey or darker colored, most often found in the upper branches if large trees. It can be most readily distinguished by the dark colored saddle-spots along the back, which are most obvious in the ligher-colored specimens, and by the bluish iris of the eyes. When it begins to rain, these lizards descend from their elevated stations in the tree, to its trunk, or, if that begins to get wet, go into holes in the ground, and during rainy weather a surprisingly large fraction of their food consists of insects obtained from the grass and other vegetation around the base of the tree which serves as their look-out post.

Fifty lizards of this species were collected between September

1923 and March 1924; fifteen from *guamá* and *jagüey* trees at Aibonito, two from *búcar* trees at Cayey, eight from *guamá* and coffee trees at Maricao, eleven, from an *jagüey* tree at Manatí, thirteen from *almendro* and *bucar* trees at Río Piedras and one from a coconut palm near the beach at the Condado.

Seven spiders formed 2.86 per cent of the total food, and had been eaten by as many lizards, of which they formed 20 per cent of the food.

Three grass mites, *Lohmannia* sp., as determined by Dr. Ewing, had been eaten by two lizards, but formed only a minute fraction of their food.

One springtail had been eaten.

One cockroach, *Ceratinoptera diaphana* Fabr., and one cricket (unidentifiable) had been eaten, besides 2 earwigs, one of which was *Doru albipes* Fabr., 1 pupa of *Chrysopa collaris* Schneider and 10 Psocids, *Caecilius* sp., totaling a little over 5 per cent of the total food.

Five hundred ants, more or less, had been eaten by the lizards, and they formed a larger item in their food than any other kind of insect, being considerably over a fourth of the total food. Nearly half of the ants were of one species, the "hormiguilla" *Myrmelachista ambigua ramulorum* Wheeler, of which 220 had been eaten and formed 12 per cent of the total food, and nearly half of the food of the lizards eating them. About 70 "albayalde", *Wasmannia auropunctata* Roger had been eaten, altho they did not amount to as much in bulk as did 7 *Pheidole fallax jelskii antillensis* Forel. Thirty-two "hormiga brava", *Solenopsis geminata* Fabr., 62 ants of various species of *Monomorium*, 10 *Iridomyrmex melleus* Wheeler, a number of *Prenolepis longicornis* Latr., and other unidentified ants had also been eaten.

Two small fig wasps, *Idarnes* sp., as identified by Mr. P. H. Timberlake, had been eaten by one lizard from a *jagüey* tree, and the lizard from Condado beach had eaten a small bee, which could not be identified.

Twenty-eight beetles had been eaten by as many lizards, forming 5.32 per cent of the total food, but in no case did a beetle form as much as half of the food of any one lizard. Eight Hydrophylid beetles, *Phaenonotum estriatum* Say, as determined by Dr. Schwarz, had been eaten by the lizard on the Condado beach. One *Loberus testaceus* Reitter, 2 Coccinellid larvae, 1 *Lasioderma serricorne*

Fabr., two unidentified Tenebrionids, 2 *Platypus ratzeburgi* Chapuis, one *Xyleborus* sp. and five *Stephanoderes* sp. had been eaten, besides 2 *Crytocephalus perspicax* Weise, 1 *C. nigrocinctus* Suffrian and 2 larvae of these beeetles.

Fourteen moths formed 9.8 per cent of the total food eaten.

Nine Noctuid larvae, of which some were *Xylomiges sunia* Guenee and *Mocis repanda* Fabr., but of which most were unidentifiable, besides 14 Pyralid larvae, three of which were *Diatraea* sp., probably *saccharalis* Fabr., together formed 15.8 per cent of the total food, and in many cases, were all, or nearly all, the lizard had eaten. The total Lepidoptera eaten were slightly over a quarter, and together with the ants, considerably over half of all the food eaten by this species of lizard.

One hundred and forty-six flies (as nearly as could be determined) had been eaten by the fifty lizards and constituted 14.66 of their total food. The greater number of these flies were small Bibionids or Mycetophylids, which did not bulk very large even when many had been eaten. Of the larger flies, two *Pyrellia scapulata* Bigot, one *Anastrepha fraterculus* Weidemann, one *Tabanus pasammophilus* Osten Sacken were identified.

Four unidentified thrips had been eaten.

Seventy-six Hemiptera had been eaten and formed 28.28 per cent of the total food.

There were 3 Capsids, one of which was *Pycnoderes incurvus* Distant; 6 Lygaeids, of which two were *Blissus leucopterus* Say and four *Orthaea bilobata* Say; 5 Jassids, of which two were *Kolla similis* Walker; one was *Deltocephalus flavicosta* Stal one *Xestocephalus pulicarius* Van D.; 8 Fulgorids, of which two were *Ormenis* spp.; 7 mealybugs, *Pseudococcus* spp.; 1 scale insect, *Saissetia hemisphaerica* Targioni; 44 Psyllids (which were 4 per cent of the total food and the largest single item of the Hemiptera eaten) and, 2 Membracids, *Monobelus fasciatus* Fabr.

Two berries of *Cordia corymbosa* had been eaten by one lizard.

SUMMARY

Adding together all the predaceous insects eaten and the spiders gives only 5.26 per cent of the food of this lizard as being beneficial, while practically all the other insects eaten are actually or potentially injurious to agriculture. One quarter of the food is caterpillars or moths, and over a quarter ants, especially such

injurious species as the "hormiguilla," the "albayalde" and the "hormiga brava."

Anolis cristatelus Dumeril & Bibron

Anolis cristatelus is the common large arboreal lizard, mottled with yellowish and greenish brown and sometimes deepening in color to almost black. The males are considerably larger than the females, and their prenuptial combats are sometimes long and fierce, but not sanguinary. This lizard is possibly the one which least fears man, and it is almost as common in and about houses in the country as on fence posts and trees.

One hundred adults of this species were collected: forty-two from mulberry, *almendro* or *bucar* trees or banana plants near the laboratory at Río Piedras, seven in the coffee grove at Vannina, south of Río Piedras, six from coconut palms or sea-grapes on the beach at the Condado, fourteen on fence posts surrounding tobacco fields at Juncos, nine in coffee groves at Ciales, four in coffee groves near Mayagüez, nine on coconut palms along the margin of a swamp near Boquerón and seven on trees growing along the dry bed of the Río Loco near Yauco, the first collection being made on September 15th, the last on December 28, 1923. They had eaten—

11 snails, which were 1.95% of the total food, or 23% of the food for 9 lizards;
24 sowbugs, 1.42% of the total food, 12% of the food for 12 lizards;
5 millipedes, 1.95% of total food, 39% of the food for 5 lizards;
2 tailless scorpions, .7% of total food, 35% of the food for 2 lizards;
3 earthworms, 2.3% of total food, 77% of food for 3 lizards, and
30 spiders, 5.15% of the total food, 23% of the food for 22 lizards.

Eight of the spiders were the large *Heteropoda venatoria*, and one was the horned spider, *Theridula triangulata* Keyserling. The total of invertebrates, not including insects, is 13.47 per cent.

Of insects, the one hundred *Anolis cristatelus* had eaten eight cockroaches which constituted 4.14 per cent of the total food, or 25 per cent of the food for eight lizards, and of these, two were identified as *Batella* sp., one *Blatella delicatula* Guerin, one *Epilampra wheeleri* Rehn, one *Periplaneta australasiae* Fabricius,

two *Periplaneta americana* Linnaeus and one *Symploce flagellata* Hebard. Five earwigs had been eaten, which were only .85 per cent of the total food, but were 21 per cent of the food for four lizards, and these were identified as three *Phaulex albipes* Fabricius, and two *Anisolabis annulipes* Lucas, the latter determination being made by Mr. A. N. Caudell. Three crickets were 1.85 per cent of the total food and 62 per cent of the food for three lizards. They were *Ellipes minuta* Scudder, *Anurogryllus muticus* De Geer and *Amphiacusta caraibea* Saussure.

Three lizards had eaten four thrips, which were 2 per cent of their food, but constituted only .07 per cent of the total food. Two of these thrips which were found in the stomach of a lizard collected October 6th, 1923, on a banana plant at Río Piedras have been determined by Mr. A. C. Morgan to be new species of *Gastrothrips.*

Two lace-winged flies, *Chrysopa collaris* Schneider, had been eaten by as many lizards and formed 22 per cent of their food, but only .45 per cent of the total.

Of the Hymenoptera, 600 individuals had been eaten by 78 lizards, but twenty-six twenty-sevenths, or 579, of these were ants, nine were bees, and the remainder wasps. But the twenty-one bees and wasps constituted 30 per cent of the food of lizards eating them, or 6 per cent of the total.

The 578 Formicidae (ants) formed 17.73 per cent of the total food and had been eaten by three-fourths of the lizards. The species identified were as follows:

2 *Anochetus* sp.
20 *Odontomachus. haematodes* Linnaeus, the "berraco," formed 2.01% of the total food, 15.5% of the food of the 13 lizards eating these large and apparently rather undigestible ants.
48 *Monomorium* sp. formed 1.42% of the total food.
85 *Solenopsis geminata* Fabr., the "hormiga brava," formed 1.69% of the food, having been eaten by 20 lizards.
90 *Pheidole fallax jelskii* Mayr, var. *antillensis* Forel, formed 4.38% of the total food, the large-headed soldiers making this species amount to practically one-fifth of the food of the 22 lizards which had eaten them.
14 *Pheidole subarmata* Mayr. var. *borinquensis* Wheeler, or some other species of *Pheidole* than *antillensis*, formed 1.07% of the total food, or one-fifth of the food of the five lizards which had eaten this species.

1 *Machomischa albispina* Wheeler (? det.).
35 *Wasmannia auropunctata* Roger, the "albayalde," formed 1.37% of the total food, or one-tenth of the food for 13 lizards.
4 *Strumigenys* sp.
130 *Tapinoma melanocephalum* Fabr. and *T. littorale* Wheeler formed 1.67% of the total food, or 18.5% of the food for 9 lizards.
21 *Brachymyrmex heeri* Forel, and var. *obscurior* Forel formed nearly 1% of the total food, or 14% of the food for 7 lizards.
97 *Prenolepis longicornis* Latreille formed 1.67% of the total food, but only 10% of the food for 16 lizards.
1 *Myrmelachista ambigua ramulorum* Wheeler, the "hormiguilla" had been eaten, altho none of the lizards collected from coffee groves were where shade trees noticeably infested with the hormiguilla were present.
7 *Camponotus ustus* Forel, a large yellow ant, formed .63% of the total food, or one-sixth of the food of the four lizards which had eaten it.
5 Honey bees had been eaten by as many lizards and constituted nearly half of their food.
4 Other bees (unidentified) had been eaten by as many lizards, but, due to their smaller size, were not such a large fraction of the food.
1 *Polistes crinitus* Felton, a large wasp, had been eaten by a lizard from a coffee-grove at Ciales.
1 Large Ichneumonid had been eaten by a lizard from Boquerón.
1 *Spilochalcis femorata* Fabr. had been eaten by a lizard at Yauco.
2 *Apanteles* spp. had been eaten by as many lizards, of which these small wasps constituted only 1% of the food eaten, as did also
1 *Tetrastichus* sp.
2 *Elis haemorrhoidalis* Fabr., females, had been eaten by a lizard at Juncos, and constituted 20% of his food.
4 *Chelonus insularis* Cresson had been eaten by lizards from Boquerón and Yauco.

Ninety-two Coleoptera (beetles) formed 16.21 per cent of total food, or one-fourth of all food for 65 lizards. Those identified were:

2 Carabids, *Solenophorus* sp.
6 Hydrophyllids
2 Staphylinids, *Xantholinus* sp.

11 Lampyrids (2.84% of total food, 28% of all food for 11 lizards):
- 1 *Lucidiota decorus* G. & H.
- 1 *Callopisma borencona* L. & M.
- 9 *Photinus vittatus* Olivier.

2 Cucujids, *Telephanus pallidulus* Chevrolat

1 Cryptophagid, *Loberus testaceus* Ritter

7 Coccinellids:
- 6 *Exochomus* sp., eaten by the lizards from the beach
- 1 *Cryptolaemus montrouzieri* Mulsant—an introduced beetle.

3 Tenebrionids

6 Bostrychids:
- 2 *Dinoderus minutus* Fabr.
- 4 *Tetrapriocera tridens* Fabr., eaten by a lizard from Boquerón.

3 Scarabaeids:
- 1 *Ataenius marginatus* Fabr.
- 1 *Ataenius stercorator* Fabr.
- 1 *Lachnosterna citri* Smyth, eaten by a lizard from the beach.

2 Cerambycids:
- 1 *Leptostylus* sp.
- 1 *Lepturges guadeloupensis* F. & S.

7 Chrysomelids:
- 1 *Lema nigripes* Weise
- 1 *Cryptocephalus nigrocinctus* Suffrian
- 1 *Nodonata wolcotti* Bryant, eaten by a lizard from Boquerón
- 1 *Disonycha laevigata* Jacoby, eaten by a lizard from Juncos
- 3 *Epitrix parvula* Fabr., eaten by one lizard from Río Piedras.

22 Curculionids:
- 2 *Cylas formicarius* Fabr., the sweet-potato weevil
- 6 *Diaprepes spengleri* Fabr., the sugar-cane root-boring weevil, forming nearly half of the food of four lizards
- 2 *Lachnopus curvipes* Fabr.
- 2 *Baris torquatus* Olivier, the eggplant stem borer
- 1 Chryptorhynchid
- 6 *Anchonus suillus* Fabr.
- 2 *Cosmopolites sordidus* Germar, the banana root-borer weevil
- 1 *Calendra linearis* Herbst, the tamarind seed weevil.

5 Scolytids:
- 2 *Stephanoderes* sp.
- 3 *Xyleborus* sp.

8 unidentified, .4% of total food
5 larvae
1 pupa

Fifty-nine caterpillars, moths or butterflies (Lepidoptera) formed 17.3 per cent of the total food, or one-third of the food of over half of the lizards. Two butterflies and five moths had been eaten, the remainder being caterpillars, of which two were Arctiids, *Ecpantheria icasia* (*eridanus*) Cramer. These had been eaten by as many lizards and formed their only food. Possibly the stiff black hairs with which these caterpillars are covered temporarily eliminated the lizards' appetite for other food. A fourth or possibly more, of the caterpillars were Noctuids and five were positively identified as being *Xylomiges sunia* Guene or *X. eridania* Cramer, and three as being *Mocis* (*Remigia*) *repanda* Fabricius. Nine lizards had eaten a Crambid larva apiece, and one of these was identified by Mr. T. E. Holloway as being *Diatraea* and probably *saccharalis* Fabricius. Six bagworms, *Oeceticus kirbyi* Guilding had been eaten by five lizards and formed 30% of their food. Another lizard had eaten two larvae of the Tineid bagworm, *Tineola uterella* Walsingham. Four larvae which appeared to be *Acrolophus* sp., an important pest of pastures, had been eaten by as many lizards.

Sixty-five flies, or their larvae or puparia (Diptera), formed 6.6 per cent of the total food, or one-seventh of the food for nearly half of the lizards. There were twelve Tipulids, one Psycholdid, three Culicids, two Mycetophylids, eight Bibionids, one Stratyomyid, *Neorondania chalybea* Wiedemann, which formed 40 per cent of the food of the lizard that ate it, two Phorids, five Syrphids, *Toxomerus* spp., eaten by the lizards around the tobacco fields at Juncos, five Muscids, of which three were *Pyrellia scapulata* Bigot, a blue-green irridescent fly, two Ortalids, *Euxesta* sp., two Mycropezids, *Calobata lasciva* Fabricius and the undescribed *Calobata* of the coffee groves, which had been eaten by the lizard from Mayagüez, one Drosophilid, eleven Agromyzids, eight larvae and one puparium.

Thirty-two bugs (Heimptera-Heteroptera) formed 3.68 per cent of the total food, and 26 per cent of the food for fourteen lizards. The large stink bugs (Pentatomidae) often constituted a third or more of the stomach contents of the lizard that had eaten one. Of the Hemiptera identified, three were *Teleonemia sacchari*

Fabricius; four were chinch bugs, *Blissus leucopterus* Say; two *Orthaea bilobata* Say; two *Largus varians* Stal, which formed 90 per cent of the stomach contents of the lizard eating them, from Mayagüez coffee grove; one *Spartocera batatas* Fabricius; one *Edessa bifida* Say, and two *Thyanta perditor* Fabricius.

Thirty-six Homoptera, including cicadas, leafhoppers, aphids, mealybugs and scale insects, formed 3.46 per cent of the total food and less than a seventh of the food for 27 lizards. A cicada, *Proarna hilaris* Germar, was all that one lizard had eaten and formed a large part of the food of another. The leafhoppers eaten were two *Kolla similis* Walker, one *Draeculacephala sagittifera* Uhler, one *Xerophloea viridis* Fabricius, one *Xestocephalus pulicarius* Van Duzee and one *Deltocephalus flavicosta* Stal. The Fulgorids included two *Bothiocera venosa* Fowler, three *Oliarus cinereus* Wolcott, one *Tangia angustata* Uhler, three *Ormenis marginata* Brunnich and two *Ormenis pygmaea* Fabricius. Three aphids, *Aphis maidis* Fitch, were 20 per cent of the food of one lizard. Six yellow mealybugs had been eaten by four lizards and five scale insects Saissetia oleae, Bernard, formed 70 per cent of the food of a lizard caught on an *almendro* tree infested with these scales.

The food of *Anolis cristatelus* by no means consists entirely of insects and other invertebrates. They had eaten fifteen red berries from various trees and bushes, *Cordia corymbosa, Volkameria aculeata,* and *Solanum seaforthianum* being specifically identified. These berries, constituted 5.19 per cent of the total food or 56 per cent of what eight lizards had eaten. Three lizards, apparently of the same species, had been eaten by as many lizards, the leg and tail usually being found, and constituted two-thirds of the food. This does not include the cases of lizards eating their own cast-off skins, which was quite common. In some cases this exuvia almost filled their stomachs. A white pigeon feather constituted half of what one lizard had eaten, and two stones, a root and some sand constituted small fractions of what other lizards had eaten.

SUMMARY

The food of Anolis cristatelus contains a larger portion of elements that are potentially or actually beneficial to man's economic interest than that of any other common lizard studied. The 2 per cent of lizards, 6 per cent of bees and wasps, mostly beneficial, .78 per cent of Coccinellid beetles, .45 per cent of Carabid beetles,

2.84 per cent of Lampyrid beetles and 5.15 per cent of spiders totals 17.19 per cent of beneficial elements. Six and seven hundredths per cent of such neutral elements as berries, roots, stones, sand and feathers, leaves 76.73 per cent of the food containing the injurious and neutral insects. But the list of injurious insects positively known to be eaten is a long one and includes such large and indigestible beetles as the "caculo" or May beetle, the "vaquita" or weevil root-borer, and the banana root-borer weevil, besides large numbers of smaller beetles, ants, caterpillars and bugs, and much more than counterbalances the beneficial insects.

Anolis gundlachi Peters

Anolis gundlachi Peters is a large brown lizard, occurring only in the higher mountains of Porto Rico, and "in many respects resembles *A. cristatellus*, which also has a caudal fin and a brownish ground color." (Stejneger.) It is not rare at the high elevations at which it occurs, but only ten specimens were collected: six between Lares and the Río Blanco at the highest point on the Lares-Yauco road, on November 6, three on the Ciales-Villalba road, 18 kilometers south of Ciales on April 30th, and one above Santa Catalina on the lower slopes of el Yunque, May 9th.

Two lizards had eaten snails and these constituted 10 per cent of the total food. One had eaten a grass mite, *Lohmannia* sp., another a large spider, *Agriope* sp., a third a white spider nest. Four lizards had eaten winged termites, most of which were *Nasutitermes morio* Latr., and these constituted 5.6 per cent of the total food, or slightly more than the Arachnids. One lizard had eaten what appeared to be the head of a dragon fly, and this was 70 per cent of its stomach contents.

Ants constituted nearly one-fourth of the total food (22.7 per cent). One lizard had eaten nothing but "albayalde," *Wasmannia auropunctata* Roger, and two had eaten "hormiguilla," *Myrmelachista ambigua ramulorum* Wheeler. Two had eaten the large "berraco," *Odontomachus haematodes* Linn., and a small amount of fragments of other ants were not identified.

Beetles constituted 10 per cent of the total food, and over half were Coccinellid larvae or their adults: *Psorolyma maxillosa* Sicard, *Cycloneda sanguinea* Linn. and one unidentified larva. A Platypus beetle, which breeds in *Inga vera* trees, had been eaten,

and *Cryptocephalus perspicax* Weise, which feeds on the foliage of the same tree.

Six caterpillars, half of which were Noctuids and half Geometrids, formed 18 per cent of the total food, and one small moth had also been eaten.

Nine flies, Mycetophilids, Tipulids and a Muscid, formed 5.3 per cent of the total food.

Two bugs, an Anthocorid and an Acanthiid, had been eaten and were 2.5 per cent of the food. One *Kolla similis* Walker and three *Xestocephalus pulicarius* Van Duzee amounted to nearly 6 per cent of the food furnished by leafhoppers, the *Inga vera* Psyllid, *Psylla minuticona* Crawford and an unidentified Fulgorid brought the total for Hemiptera-Homoptera up to 11.5 per cent.

The lizard from el Yunque had eaten two large seeds.

SUMMARY

The only food elements of the lizard that might be considered beneficial are the spiders and the Coccinellid beetles, and these amount to only about a tenth of the total food. Many of the other insects are neutral in their economic aspects, to the interests of man, but some of them, especially the ants, are decidedly injurious. The common coffee shade tree, *Inga vera*, furnishes food for many and various insects, and quite naturally, most of these insects are represented in the food of a lizard occurring where these trees are most abundant.

CONCLUSION

The results of the investigation conclusively prove that the lizards of Porto Rico are of very considerable economic benefit to the agricultural interests of the Island, and their value in preventing an enormous increase in numbers of some insects which we now think of as only minor pests, can with difficulty be realized.

"Few insects . . . have caused such enormous pecuniary losses as has the chinch bug (*Blissus leucopterus* Say). No other insect native to the Western Hemisphere has spread its devastating hordes over a wider area of country and with more fatal effects to the staple grains of North America than has this one." (7) "The chinch bug has damaged Kansas crops to a greater extent than has any other injurious insect, for, from the time the settlers began, to plant the prairie to the present it has exacted merciless toll . . . Although there is no way to determine accurately the

money value of crops destroyed by the chinch bug since Kansas was first settled, it is safe to assume that the amount reaches many billions of dollars." (8) Yet the chinch bug is a very minor pest in Porto Rico and does appreciable damage only when the little yellow-striped grass lizard is rare.

This is the most striking instance of the economic value of lizards in Porto Rico, yet hardly more than equals the value of this same lizard in eating many small caterpillars before they become sufficiently numerous to cause serious damage.

The caterpillar which bores into the shoots and stalks of sugar cane (*Diatraea saccharalis* Fabricius) was noted with surprising frequency in the stomachs of several kinds of lizards, and this despite the protection which its burrowing habit would appear to give during most of its existence as a larva. It is a common and destructive pest of sugar cane, more especially in the dryer sections of the Island, and this may in part be due to the comparative scarcity of lizards along the south coast. But its abundance thruout the Island, and the damage it might cause, is undoubtedly limited by the presence of the lizards.

The ants eaten by lizards bulk large in their food, and this despite the small size of the individual ant. If ants at times seem especially abundant, one can well imagine how numerous they might easily become were the lizards not present in such abundance to destroy them.

There are many insects eaten by lizards which are at present neutral in their economic relations to the interest of man, and others that, altho attacking cultivated crops, are so rare that they are rather of academic interest than even minor pests. Yet if the lizards were not present to do their part in keeping down the numbers of insects, many of them might become very appreciably injurious.

Altho a considerable fraction of the food of the common large brown or black tree lizard, *Anolis cristatelus* proves to be of beneficial insects, yet it is a most valuable species because of its large size. It is large enough to eat such large, apparently unpalatable and hard-to-digest beetles as the weevil root-borer or "vaquita", *Diaprepes spengleri* Linnaeus, the banana root-borer, *Cosmopolites sordidus* Germar, and even the May beetles or "caculos", *Lachnosterna* spp. The *iguana,* Ameiva exsul, is amply large enough to eat such beetles, and does in fact eat the white grubs which are the im-

mature stages of the May beetles, but it is exclusively terrestrial and would rarely have the opportunity to catch the "vaquitas," which hide in the leaves of the trees where they feed. The *iguana* is also exclusively diurnal and the large tree lizard is so largely so that neither of them have any real opportunity to catch the May beetles, which are just as exclusively nocturnal. Indeed the white grubs have so few natural enemies in Porto Rico that the importation of additional ones from other countries offers one of the most promising methods of reducing numbers. Altho the small tree-toads or "coquís" are abundant in Porto Rico, there are no large nocturnal native toads large enough to eat May beetles. Such large toads are found in most of the other West Indies and on the mainland, and keep the number of May beetles, and their larvae, the white grubs, so reduced that they are seldom pests to cultivated crops. Mr. D. W. May of the Mayagüez Station, about four years ago obtained a dozen toads, *Bufo agua* Daudin, from Barbados, which were released here. They appear to be thriving and their descendants have been reported as far as four miles away from the point of release. Eventually, with an increase in their numbers, they will doubtless spread more widely over the Island, but it would be desirable to make other and larger importations of this or other species from Barbados or elsewhere, and immediately begin to obtain the benefits in decreasing the numbers of white grubs which would ensue from their presence in the canefields of Porto Rico.

Altho the nocturnal *Lachnosterna* beetles are rather rarely eaten by the large tree lizards its value in destroying not only such large diurnal beetles as the weevil root-borer and the banana root-borer, but also many other smaller beetles which are pests of various crops, should not be minimized. Beetles constitute a much larger part of its food than of any other common lizard, and very few of these beetles are beneficial.

There are no records of grasshoppers ever being sufficiently abundant in Porto Rico to be a pest of crops. That this is entirely, or even largely, due their being eaten readily by lizards can not be affirmed, but undoubtedly the lizards are a contributing factor. The number of cockroaches eaten is surprisingly large, considering their nocturnal habits, and presumably if they were active during the day, as are the grasshoppers, they would be no more abundant. Undoubtedly the reason why the *changa, Scap-*

teriscus vicinus Scudder, is so rarely eaten by lizards is because it is strictly nocturnal and largely subterranean in habits, and this again suggests the benefits to be derived from the importation of large nocturnal toads.

No mosquitoes, nor house flies, were found in any of the lizard stomachs examined, and the great bulk of the flies eaten were neutral in their relation to man, their larvae being for the most part scavengers in decaying vegetation. But as no beneficial Tachinid or Syrphid flies had been eaten, the role of the lizards as fly-catchers is interesting rather than important.

All the insects which lizards eat are not inimical to the interest of man. But altho some few are beneficial, and a considerable number are neutral, the injurious and destructive insects bulk so much the largest as to mark the lizards as being most beneficial and desirable allies of man.

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FIRST SUPPLEMENT TO INSECTAE PORTORICENSIS

Because the question has been asked, and to avoid further uncertainty, it should here be definitely stated that, unless otherwise specified, the descriptions appearing in *Insectae Portoricensis* of new species are by the compiler of the list, George N. Wolcott.

P. 16.

Dr. J. W. Folsom has given the MS. name of **Cremastocephalus bilobatus** to the green Collembola commonly found on canna, water hyacinth, *yautía,* corn and sugar cane, discussed by Wolcott 21–10.

P. 20.

For **Periplaneta australiae** Fabricius, read **Periplaneta australasiae** Fabricius.

P. 32.

Glyptotermes pubescens has been described by Dr. T. E. Snyder in No. 2496, Proc. U. S. National Museum, Vol. 64, Art. 6, pp. 1–40, pl. 1–5, 1924.

Nasutitermes (Tenuirostitermes) wolcotti has been described by Dr. Snyder in the Proceedings Entomological Society of Washington, Vol. 26, No. 5, May 1924, pp. 131–132.

P. 33.

For **Pseudocaecillus,** read **Pseudocaecilius.**

Mr. Rolla P. Currie has examined a small collection of Odonata from Porto Rico, and finds that the only species not recorded by Kolbe and Gundlach is **Scapanea frontalis** Burmeister.

He makes the following changes in the list of Odonata:

Erythragrion dominicanum Selys is now known as **Telebasis dominicana** Selys.

Erythragrion vulneratum Hagen is now known as **Telebasis vulnerata** Hagen.

For **Aeschinidae,** read **Aeschnidae.**

For **Gymnacantha,** read **Gynacantha.**

Libellula umbrata Linn. is now known as **Erythrodiplax umbrata** Linn.

Orthemis discolor Burmeister is now known as **Orthemis ferruginea** Fabricius.

Dythemis discreta Hagen (which should have been spelled **dicrota**) is now known as **Micrathyria didyma** Selys.

Diplax ambusta Hagen is now known as **Erythrodiplax connata justiniana** Selys.

Diplax portoricensis Kolbe (which should be **portoricana**) probably belongs in the genus **Erythrodiplax,** along with *minuscula.*

For *D. miniscula,* read *D. minuscula.*

Mr. Currie has also bracketed the names of most of the authors, showing generic transfers, but for consistency with the rest of the list, these are not here indicated.

P. 42.

Under **Odyneurus dejectus** Cresson, add

a large cluster on asparagus frond (224–23 det. Rohwer).

P. 43.

Under **Pseudagenia bella** Cresson, add

reared from mud nests on the leaves of *Inga vera* at Cayey (366–22 det. Rohwer).

Under **Crabro croesus** Lepeltier, add

reared from cocoons in rotten log (78–23 det. Rohwer); on Mona Island (1308–13).

P. 44.

Under **Notogonidea vinulenta** Cresson, add

on Mona Island (1310–13 det. Rohwer).

P. 60.

For the author of **Aspidiotiphagus citrinus,** instead of Crawford, read Craw; Dr. L. O. Howard states "it was Alexander Craw who described this species."

P. 65.

Add

Pimpla rufoniger Cresson — det. Cushman
at Aibonito (SSC).

P. 80.

For **Omalodes kugii** Marseul, read **Omalodes krugii** Marseul, add

Carnicops dominicana ? Marseul — det. A. J. Mutchler
under bark of *Erythrina* tree at Cayey (248–17).

P. 93.

Add

Stethorus punctum LeConte — det. Sicard (previously determined by Dr. Schwarz as "close to *punctum Lec.*")
on leaves of *Psidium guajava* and *Spondias lutea* (88–13, 722–16, 838–16).

P. 94.

After **Psyllobora lineolate** Fabricius, add

—confirmed by Dr. Sicard

and delete "presumably this species" on the next line.

P. 113.

For **Noda** sp. or **Nodonota** sp. — det. Cotton, read

Nodonota wolcotti Bryant, G. E., *in* "New Species of Phytophaga" Annals and Magazine of Natural History, Ser. 9, Vol. 13, p 299, March, 1924, TYPE from Porto Rico.

P. 116.

For **Homophoeta aequinoctailis** Fabricius, read

Homophoeta aequinoctialis Fabricius

P. 117.

Add

Hermaeophaga cubana Bryant, G. E., *in* Annals and Magazine of Natural History, Ser. 9, Vol. 13, p. 302, March, 1924, TYPE from Porto Rico.

millions on a few unidentified trees near Guayama (50–22).

P. 129.

After the last record under **Lachnopus coffeae montanus** Mar shall, add

feeding on leaves of *Cestrum macrophyllum* Vent. (host de termination by R. A. Toro) at Ciales (34–24).

P. 209.

Add

Root, Francis Metcalf, "Notes on Mosquitoes and other Blood-Sucking Flies from Porto Rico." *In* American Journal of Hygiene, Vol. 2, No. 4, July 1922, pp. 394–405, figs. 5.

Notes on the following species:

CHIRONOMIDÆ.

Culicoides furens Poey (Syn. **C. maculithorax** Williston)

SIMULIIDÆ.

Simulium quadrivittatum Loew

CULICIDÆ.

Anopheles albimanus Wiedemann

Anopheles grabhamii Theobald

Uranotaenia socialis Theobald

Uranotaenia lowii Theobald

Aedes (Stegomyia) aegypti Linnaeus

Aedes (Taeniorhynchus) portoricensis Ludlow

Aedes (Ochlerotatus) ? condolescens Dyar & Knab ? (larva described)

Psorophora jamaicensis Theobald

Culex (Culex) quinquefasciatus Say (Syn. **C. fatigans** Wied.)

Culex (Culex) nigripalpus Theobald, var. **similis** Theobald

Culex (Melanoconion) atratus Theobald (Syn. **C. falsificator** D. & K.)

Culex (Choeroporpa) borinqueni sp. nov. Root

"The commonest 'wild' *Culex* of the Porto Rican costal plain. . . . . found breeding in all sorts of slow streams, pools and marshy places, ... at Río Piedras, Martin Peña and Aguirre."

Deinocerites cancer Theobald

TABANIDÆ.

Chrysops costatus Fabricius — "mosca de manglar"

MUSCIDÆ.

Stomoxys calcitrans Linnaeus

P. 217.

For **Conicera aldrichii** Brues, read

Conicera latimana Malloch, J. R., "A New Species of **Conicera** from Porto Rico" *in* Proc. Ent. Soc. Washington, Vol. 26, No. 4, p. 73, April, 1924, TYPE from Porto Rico.

(as *Conicera aldrichii* Brues) Wetmore 16–74, eaten by hummingbird, *Anthrocothorax aurulentus*.

P. 222.

To the rearing records of **Nemorilla maculosa** Macquart, add

from *Tetralopha scabridella* Ragonot at Cayey (385–22 det. Aldrich).

About the middle of the page, add

Phorocera parviteres Aldrich — det. Aldrich

from *Pieris monuste* Linn. at Yauco (77–23); (sp.) from *Melanchroia cephise* Cramer (6–24).

P. 225.

The rearing records for **Sarcophaga robusta** Aldrich are incorrect for this species. It should read

Sarcophaga robusta Aldrich
Aldrich 16–268: from Mayagüez, P. R.

Sarcophaga sternodontis Townsend
Aldrich 16–267: from Mayagüez, P. R.
Jones & Wolcott 22–49: from pupae of *Mocis (Remigia) repanda* Fabr. and from white grubs.
(452–12, 766–12, ... etc.

P. 239.

Mr. A. C. Morgan of Clarksville, Tenn. has identified the following thrips (Thysanoptera) which are new to Porto Rico, and will describe the new genus and species in a forthcoming paper.

TEREBRANTIA.

Cercyothrips gen. et sp. nov.
collected by E. G. Smyth, October 7, 1919 at Río Piedras (685–19).

Limnothrips cerealium Haliday
on sugar-cane leaves at Guánica, March 18, 1920 (GNW).

Corynothrips stenopterus Williams
on "yuca", *Agava sissalana*, Nov. 18, 1919 at Río Piedras (788A–19).

Franklinothrips vespiformis Crawford
collected by E. G. Smyth at Río Piedras.

Heliothrips fasciatus Pergande
on alfalfa at Río Piedras, Nov. 16, 1923 (349–23), collected by F. Seín.

Anaphothrips sp. nov.
four females from leaves of sugar cane at Bayamón, May 5, 1920 (GNW).

Sericothrips sp. nov.
two females collected by E. G. Smyth at Río Piedras, March 25, 1920.

TUBULIFERA.

Ommatothrips gossypii Hood
on coffee leaves (GNW); on leaves of *Inga vera* at Cayey (306–23).

Gastrothrips sp. nov.
in stomach of lizard, *Anolis cristatellus* D. & B., Oct. 3, 1923 (308–23).

Diceratothrips sp. nov.
in rotten cotton boll injured by Pink Bollworm at Pt. Cangrejos (307–23); on leaves of *Inga vera* at Cayey (306–23).

Lissothrips subgen. et sp. nov.
from stomach of lizard, *Anolis stratulus* Cope, collected May 9, 1924, at Hacienda Santa Catalina, Mameyes by F. Seín.

Hindsiana cocois Watson
on leaves of sugar cane at Camuy, April 26, 1920 (GNW).

Hindsiana weigeli Watson
(probably from sugar cane) at Río Piedras, Feb. 23, 1920 (GNW).

P. 244.

For VELIDAE, read VELIIDAE.

P. 257.

For wild Bougainvillea vine, read *Trichostigma octandra* (L.) H. Walt (host determination by R. A. Toro).

P. 270.

Add

Cubana tortriciformis Muir MS sp. nov.
from el Yunque (29–24).

P. 281.

To the host records of **Pseudococcus bromeliae** Bouché. add
on aerial roots of "jagüey", *Ficus laevigata,* attended by "hormiguilla", at Manatí (24–24 det. Ferris).

Also add

Pseudococcus comstocki Kuwana — det. Ferris
from stomach of lizard, *Anolis pulchellus* D. & B., at Toa Baja (lizard No. 306).

P. 291.

Add a host record for **Pseudoparlatoria ostreata** Cockerell,
on *Piper medium* stems from Manatí (25–24 det. Ferris).

P. 306.

Add

Opogona 206

o-O-o

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"MISCELLANEOUS PAPERS ON SUGAR-CANE TECHNOLOGY"

PUBLISHED BY

THE INSULAR EXPERIMENT STATION

Río Piedras, P. R.

(Issued November 1924)

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[1] As of date of issue, October 1924.

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FOREWORD

The papers which appear in this and the following number of the "JOURNAL OF THE DEPARTMENT OF AGRICULTURE OF PORTO RICO" have all been read at the meetings of the "*Association of Sugar Technologists of Porto Rico.*" The papers which were presented at the first meeting of the Association which was held on June 17, 1922, at the Carnegie Library, San Juan, P. R., were published as Vol. I, No. 1 of the "*Memoirs of the Association of Sugar Technologists of Porto Rico.*"

During the last year, the work and development of the Association has become so intimately connected with the Department of Agriculture and Labor of Porto Rico, and especially with one of its branches, the Insular Experiment Station, that it has seemed advantageous to publish its proceedings in the "JOURNAL OF THE DEPARTMENT OF AGRICULTURE", a periodical which has attained a wide reputation and circulation among the scientific world. Consequently, Nos. 2 and 3 of Vol. VIII of THE JOURNAL have been assigned to the publication of miscellaneous papers on sugar-cane culture and manufacture. No. 2 will contain a number of interesting papers which were read at the meetings held on January 5, 1923; June 17, 1923, and June 14, 1924, while No. 3 will be taken up by an article of our Cane Technologist, Mr. Arthur H. Rosenfeld, on the "Java P. O. J. Canes in Tucumán and Porto Rico".

A word about our Association. The necessity of this association was strongly felt by our trained men in the different fields of our sugar-cane industry. Thanks to the initiative of Prof. F. S. Earle and other enthusiastic men, a preliminary meeting was held in San Juan, early in April, 1922. The first regular session was held on June 17, 1922, and a large number of our prominent sugar men were present. Prof. F. S. Earle, was chosen first president, and the Association held its own with enthusiasm for a year or so. Unfortunately for us, the "old man" left his position in Central Aguirre, to accept a more lucrative one with the General Sugar Co. interests

in Cuba. Professor Earle's departure was a hard blow on us, but our spirit did not die out, and our last meeting, held on June 14, 1923, was a great success. The audience was honored with the presence of Prof. F. D. Kern, dean of the graduate school of the Pennsylvania State College, and Prof. H. H. Whetzel, of the Department of Plant Pathology, Cornell University. Both of these gentlemen delivered short addresses which were well received. Practically all the centrals of the Island were represented at the meeting.

It may be safely assured that our organization has already visualized the great possibilities which may develop in the future, in the way of lending a helping hand to our colleagues from Cuba and Santo Domingo, who according to late reports are very badly struck with the mosaic disease and the variety problems. Will our Association in the future extend its scope to the rest of the West Indies, or possibly to the rest of the sugar-producing countries of America?

CARLOS E. CHARDÓN,
President.

SUGAR-CANE CULTIVATION

By F. S. EARLE, Agronomist, Central Aguirre

Sugar-cane agriculture in the West Indies is fifty years behind the manufacturing side of the industry. It is hard to understand why this should be so, but no one conversant with the facts will dispute it. Nothing is more urgently needed than to bring the work in our cane fields into accord with the farm practices long recognized as indispensable in the growing of other similar crops. Sugar cane, in order to produce a maximum yield, requires a heavier rainfall or a more abundant supply of irrigation water than is needed for most crops, and it needs it, too, for a longer period. Now the only known way to supplant rainfall and to conserve soil moisture is by giving frequent surface tillage to form and preserve a dust mulch. This has been thoroughly understood for many years and it is the regular practice with all similar crops. Why not with sugar cane, which needs it even more? In the corn belt no one thinks of planting corn without giving it constant cultivation. Even as drouth-resistant a plant as cotton is cultivated most carefully. In Louisiana cane is cultivated like a corn field. It is only here in the West Indies, on the hardest and most compact soils and with the most capricious of rainfalls, that we expect cane to grow and yield full crops year after year without this fundamentally necessary assistance. Our present methods have come down to us from the times when cane was planted on new lands—freshly cut-over timber lands. No special cultivation was needed then, nor is it needed today on such new lands. The humus which they contain so abundantly holds moisture and the decaying rootlets leave the ground porous and well aerated. All this changes with age as the soils become hard and compact, when this porousness and permeability to air, so necessary for plant growth, has to be restored by tillage. The roots of sugar cane are very susceptible to lack of air. When the soil becomes encrusted they quickly suffer and are apt to be attacked by the fungi causing "root disease", a condition causing more losses to cane on old lands than all of the other cane troubles combined. It is "root disease" that has coused so many of the old standard varieties to fail as the land becomes more hard and compact through continued cropping and the loss of vegetable matter. In one country

after another first Otaheite and the Rayada and Cristalina have gone down and been abandoned on account of "root diseases." This trouble has caused the loss of untold thousands of dollars in all parts of the sugar-cane growing world, and yet it is easily controlled. Three things are required, and of these each is as important as the other: first, proper drainage; second, abundant fertilizing, and third, frequent tillage. Used with good judgment and common sense these three things will prevent nineteen-twentieths; yes, ninety-nine hundred of the cases of root disease, and at the same time will so increase yields that they will prove a decided economy and not an expense.

More tillage, then, is a necessity if we are to secure full yields of cane on old lands, first, to conserve moisture and, second, to aerate the soil so that the roots may be supplied with oxygen, for they are living things and, like everything else which has life, they take in oxygen and give off carbonic-acid gas. When the soil is hard and encrusted this necessary exchange of gases is impeded and the vitality of the plant suffers. Anything which lowers the vitality of the cane plant permits the attacks of the root-killing fungi. Again, the presence of oxygen in the soil is necessary for the growth of those soil bacteria that are instrumental in transforming the crude plant food contained in the soil intc nitrates and other forms in which it is available for growth. In badly aerated soils another set of organisms develop which destroy these nitrates and thus rob the soil of its fertility. Some recent investigators have gone so far as to claim that this effect of tillage in rendering the plant food in the soil more available is the real reason for its beneficial effect during period of drouth. The soil solution is made richer in plant food and so less of it is required to keep the plant in active growth. Be this as it may, the outstanding fact remains that frequent shallow tillage during dry weather aids remarkably in keeping crops in active, vigorous growth. Why, then, do not cane planters, like other farmers, take advantage of this long-known and well established fact? The only answer is that they are still blindly following the customs of their fathers: customs sufficiently well adapted to the fresh new lands of those times, but not adapted to the compacted and partially exhausted lands of today.

By tillage is meant any stirring of the surface soil between growing plants with implements. This may, of course, be done by hand with the hoe or rake. The surface scraping usually done with

the hoe in Porto Rico can hardly be called tillage since it does not brake the surface crust. Usually it is more cheaply and effectively done by implements drawn by animal power. Mules and horses are better adapted to this work than oxen and usually their work is much cheaper. Tillage by tractors is surely coming in the near future, but so far it has hardly passed the experimental stage. The kind of implement to use for cultivation will depend on the system of planting adopted and to some extent on the nature and condition of the soil. The more generally useful tools are the 5-shovel cultivator, the 13-tooth harrow cultivator, the double shovel, the single shovel or Georgia stock with its various attachments and the small 7-inch turning plow. First one and then another of these implements should be used according to the condition of the land and the amount of weed growth. The small reversible disc harrow with only six discs is often very useful, especially when the land was crudely prepared. The straddle-row riding cultivators had best not be attempted until after our labor becomes accustomed to handling these simple instruments. When properly handled these implements, working as they do on both sides of the row at once, are great savers of time.

There are three principal systems of cane planting in use in Porto Rico. Each will require special methods of cultivation in order to secure best results. The irrigated lands are mostly planted on the Hawaiian system, first successfully introduced by the late Patrick MacLain when he was Administrator of Central Aguirre. In this method the cane is planted at the bottom of deep furrows which are laid out as nearly as possible on the level grade lines. These planting furrows are crossed at intervals of thirty to forty feet by light furrows for bringing in the water. This secures a more uniform distribution of water than is possible with the old system of running the rows with the grade and allowing the water to follow them for considerable distances. Having to maintain the banks between the rows to confine the water makes tillage more difficult than where level culture is possible. This has been made an excuse for doing little or no cultivation on the irrigated lands of the southern coast where the tendency has been to depend on irrigation water alone to make the crop. This is a serious mistake, especially in the ratoon fields. Much better results will follow if each irrigation is followed within a few days by a cultivation to break the crust and restore a dust mulch. From 20 per cent to 25

per cent less water will be required and better crops will be secured. For this cultivation it is best to alternate, using first the harrow-cultivator held at an incline first on one side of the bank and then the other. This implement tends to pull down the banks and after using it a few times the 5-tooth cultivator should be substituted for it, putting on the broad hilling-up wings that come with it and taking off the three forward shovels. The wings should be set to turn the dust toward the middle and the width should be adjusted to fit the bank. This will restore the central ridge to hold in the irrigation water. The single shovel or Georgia stock with a 16-inch "heel sweep" may now be used between this central ridge or bank and the cane to clean out and open up the water furrow. By the alternate use of these three cheap and simple implements irrigated cane may be cultivated easily and effectively. Simply follow every irrigation or rain by a cultivation. That is an easy rule to remember.

Dry uplands that are unirrigated and where no extensive drainage is required are best planted on what may be called the Cuban system, since it is employed so widely in that island. The cane is planted in deep furrows as for irrigation but, it is usual to run through with enough slope to carry off an excess of rainfall. These furrows are gradually filled in by the cultivation and when the cane is laid by the ground should be nearly level. This is the simplest kind of cane cultivation. The seed should be placed in a single continuous line in the bottom of the furrow—not in a double line nor in wide "holes" with spaces between, for this leaves space that requires hoe work. Any of the above-mentioned implements may be used with this system of planting. If done frequently enough to destroy the grass and weeds as they are sprouting, the 13-tooth harrow-cultivator will be the only implement needed, and, if care is taken each time to run close to the cane, almost no hoe work will be required. If continued rains do not permit cultivation and the cane gets grassy it will be necessary to use either the double shovel or the small turning plow, but these implements should be followed closely by the harrow-cultivator. It will pay to run the cultivators as often as every ten days, or in some cases even oftener. Always cultivate as soon as possible after a heavy rain. Remember you are not cultivating primarily to kill weeds but to aerate the soil. Weed killing is a useful secondary benefit.

All wet lands that require drainage should be planted on the

Porto Rican *gran banco* system. Many Porto Rican cane lands are of this nature and this system has been developed here locally to meet these conditions to which it is admirably adapted. In Louisiana cane is also planted on low, wet lands. There they meet this condition by planting on top of sharp single-row ridges. The land is prepared much as for planting according to the Cuban system, but the cane is planted on top of the bank and not in the furrow, which is kept open for drainage. This Louisiana system would not be well adapted to Porto Rico since here cane even on wet lands sometimes suffers from drouth and these narrow ridges would dry out unduly. The Porto Rican *gran banco*, wide enough for two cane rows, do not dry out so quickly. When laborously made by hand with the shovel, which is still the usual practice, they are very expensive. In most cases there is no need at all for this and it is a custom which should be immediately abandoned. No conceivable "protection duty" will serve to make cane growing permanently profitable if such expensive practices are followed. Most of these wet lands are dry enough at some season of the year to admit of preparation with the plow. They should be prepared at such times. Deep plowing is not required but the surface should be well pulverized by several harrowings. Then lay off the banks with a big turning plow giving two cuts in the same furrow, and removing as deep as possible. Clean the furrow either with the big double mould board (*bombo*) or with the Martin grader or with both, and the banks are made. Open a light furrow on either side of the bank with a 7-inch turning plow as a guide in planting and plant in a single line (*chorro*). Do not destroy the bank by making a deep furrow for planting and do not plant in holes for this makes your rows so wide that there is no space for cultivation. Cultivate on top of the bank with the harrow cultivator much as in the Cuban system. Before the ditches get set with grass clean these with a pass of a medium-sized double-mould-board plow. The one used in Cuba for opening planting furrows and there called a *limpiador* will be about right. This will keep the ditches clean much cheaper than it can be done by hand. On very wet lands where there is constant standing water in the ditches the above directions cannot always be carried out. In such cases it is usually better to make wide 20-foot banks with deep permanent ditches between them. These will likely have to be made by hand and they should be carefully run in the direction to give best drainage. After the ditches are opened the land will soon dry enough so that the

top of the bank can be prepared with a small 8- or 10-inch plow. There will be room for four rows and level cultivation can be given. This plan is working well in actual practice.

Whatever plan of planting is followed it is of great importance to put at least 400 pounds of fertilizer per acre in the planting furrow before planting. A second application can be given at the side of the cane row when it will be covered by the cultivation after the cane is two to three feet high. Subsequent applications, however, cannot take the place of this first one in the bottom of the planting furrow. This not only places it where it will be immediately available for the young roots as they form, thus insuring a vigorous early growth, but, by its deep application it induces a deep rooting habit that better enables the young plants to resist drouth. Applications made after planting are necessarily placed above the roots and the tendency is to induce a shallow root growth. The importance of this matter cannot be too strongly insisted upon, though it seems to be little understood in Porto Rico.

It is, however, in the ratoons that better cultivation is most urgently needed. With plant cane the ground has been thoroughly loosened and mellowed in the preparation for planting so that in many cases fairly satisfactory growth is secured with a minimum ot cultivation. In the ratoons the soil has been compacted by the trampling of men and teams in getting off the crop and it is of urgent importance to restore it as soon as possible to a condition of mellowness and good tilth. The practice should be much the same with either of the systems of planting. First line the trash in alternate middles and let it lie there as a mulch throughout the season. This reduces the area to be cultivated by one half. The expense of transferring the trash and working the second middle may usually be avoided since the heavy mulch tends to soften and mellow the soil beneath it. Each row will therefore be mulched on one side and cultivated on the other, thus getting the benefit of both. In the case of *gran banco* plantings, however, it will be necessary to at first line the trash in the ditches and later transfer it to the top of the bank after that has been thoroughly pulverized. As soon as possible after lining the trash and before much new root growth has started, "bar off" each side of the cleaned middle with a 10-inch ploy running as close to the cane as possible and throwing the dirt toward the middle. In the furrow thus formed put in the first application of fertilizer. On most soils it will be best

to mix this in the soil by passing a subsoil flow to stir and open up the soil still more deeply. This should be immediately followed by the harrow-cultivator to pulverize the furrow sluices that have been thrown out and to partially fill the furrows and cover the fertilizer. After this the work will be about the same as in plant cane. An implement of one kind or the other should be passed every ten days or two weeks until the cane closes. The main point is to see that it is passed quickly enough after each heavy rain to prevent baking and the forming of a heavy crust that will impede aeration.

The expense of the method of cultivation here outlined will be but little if any greater than at present since it will save the larger part of the hoe work. It will largely increase yields and will make possible the taking of many more ratoon crops than at present. Above all, nine-tenths of the present losses from root rot will be avoided. Try it out carefully, gentlemen, and see the results for yourselves.

CANE VARIETIES RESISTANT TO SALT LANDS

By F. S. Earle, Agronomist, Central Aguirre

On both coasts of Porto Rico there are various tracts of land too salty to permit the growth of the ordinary sugar-cane varieties. In some cases heavy losses have been made in attempting to plant these lands. These salty tracts are more frequent on the dry, south coast, and here unfortunaly some tracts, formerly productive, have become salty owing to carelessly allowing irrigation water to stand and evaporate in low places. Some work is being undertaken to see if such lands can be reclaimed by proper banking and ditching. In this connection it becomes important to know which cane varieties have most resistance to salt and consequently which it will be safest to first plant on these lands. It had already been observed that Uba and Sealey's seedling showed rather more resistance than Crystalina, while Yellow Caledonia and Cavengirie were if anything more susceptible.

To test this matter farther, on September 20 ninety-three varieties were planted in small plots of about 20 seeds each on land so salty that a planting of Crystalina made last March had completely failed. The differences in the behavior of these different kinds is very interesting, although it is still too early to draw final conclusions. The usual effect of salt is to retard germination even where it does not prevent it. As was to be expected the germination was slow and uneven. After three weeks only 4 kinds showed as many as 20 shoots, 23 showed between 10 and 19 shoots, 27 kinds had 5 to 9 shoots, 34 kinds 1 to 4 shoots and 4 showed no germination. Some of those that germinated most promptly and uniformly soon began to turn yellow and fail. There are others, however, that continue to show good color and vigor. It is quite noticeable that a much larger percentage of these are found among the Demerara seedlings than among those from either Barbados or Porto Rico. There are 8 Demerara kinds in the experiment and all of them except D-433 are so far quite satisfactory. Of the 17 Barbados kinds only two or three are equally good, while of the 41 Porto Rican kinds only two or three are good while many are failing completely. This result was perhaps to be expected since the Demerara kinds were bred and selected on low, maritime lands protected from the sea by dikes where

the soil must of necessity be still somewhat salty. Naturally only those that can resist these conditions have been selected. The Barbados and Porto Rican kinds, on the contrary, have been bred on uplands and were selected with no reference to salt resistance.

Among those making the best showing at the present time may be mentioned Bamboo Blanca, Penang, Rosa Morada and Uba, among the older named kinds; and B–208, B–6536 and BH–10(12) among the Barbados kinds. Among the Demerara kinds D–117, D–448, D–504 and D–625 are best showing full stands and good vigor. D–109, D–350 and D–1135, have equally good shoots but the stand is broken. Among the Porto Rican seedlings PR–333, PR–460, PR–16(874), PR–18(153), and PR–18(171) still give some promise, but PR–202, PR–207, PR–260, PR–271, PR–328, PR–417 and PR–449 are already complete failures.

The final result of this experiment will be of great interest and considerable practical importance.

IMPLEMENT TILLAGE FOR IRRIGATION

By R. L. PAGE, Manager of Cultivation, South Porto Rico Sugar Company

The task of introducing implement tillage into a country where this method of cultivation has never been practiced, is one beset with many difficulties. In the first place, I don't believe there is a business under the sun, where inefficient work will show up to worse advantage than poor work in cultivation with implements. And the economical results of poor cultivation are equally disastrous.

Therefore, it is easy to comprehend what one has to contend with when you try to introduce this work into a country where there are no teamsters, and where none of the laborers have the slightest conception of the principle of the implement, and the *mayordomos* are very slow indeed in learning to use judgment in putting different instruments in the different fields as conditions change.

Another idea which we have not been able to impress on our *mayordomos*, is that implements should be confined to such territory as they can attend to properly, and leave the rest of the work to be attended to by hand.

Another condition that was met with here. These fields never have been cultivated by animal power, so were not layed out with the idea of accommodating this kind of work.

Also each country has its peculiar conditions that required certain implements. Some of them may be found on the market, and others have to be improvised. These are a few of the things that have to be contended with while introducing a proposition of this kind. However, they are minor details, all of which may be overcome in time.

The chief questions that have to be determined are whether or not you are able to cultivate a piece of land cheaper by this method, whether you can produce more tons per acre, and whether or not you are able to make as good use of a limited water supply for irrigation.

In discussing tillage with irrigation there are two distinct propositions to consider:

One, where you have an abundance of cheap water, where the only object in cultivation is to maintain a good soil condition for the cane, and the other, where you have a very limited supply of

expensive water and where the only object is to make a gallon of water reach over as much territory as possible, never pretending to give the plant all the water it wants, merely holding it up until it rains.

The former is quite simple, and there really is not much room for discussion. I have had occasion to introduce cultivation into a proposition of this kind and in many instances obtained an increase of 100 per cent in yield and a material reduction in cost.

However, with the latter, where we have a great scarcity of water and the water is very expensive, we meet with greater difficulty, and we have to proceed with more care and judgment than where water is plentiful and cheap.

As the condition of scarcity of water obtains more generally in the better cane districts in Porto Rico, I will discuss the subject under these conditions.

The primary principles of conservation of moisture in dry farming are well known to most every one, and these are the principles which have to be applied to cultivation with irrigation under these conditions, where conservation of moisture is of primary importance.

On undulating lands and in districts frequented by drought, there is no question but that the deep-furrow system is the most desirable. First, from the view point of controlling the irrigation water; second, from the fact that moisture is conserved longer in a deep furrow than in a shallow furrow, or on level land, providing proper mulch is maintained.

In carrying on intensive cultivation with implements, in connection with the deep-furrow system, the problem which presents itself is the one of conserving the banks for the purpose of controlling the irrigation and at the same time keeping soil in good condition without filling up the furrow too much.

In making a study of this phase of the problem, I have come to the conclusion, that in loose land where it may be desirable to work two animals abreast, the least practical width that banks can be made is 6 feet from centre of furrows. Anything narrower than this, where furrows are made with a large *bombo* (lister) with bulls or steam plows, lister or furrow machine, it is not practical to get onto the banks with an animal-drawn implement, as they are thrown up so high and steep that it is hard walking for the animals, and the implement will roll entirely too much dirt down into the furrow.

A 6 feet bank allows a furrow of sufficient depth and at the

same time a bank wide enough for animals to walk on without filling the furrow with dirt and clods. In this connection would state that where a good bank is made, as with a steam plow, it is not practical to go in with cultivators, until the banks have had time to settle, or have been worked down a little either with hoes or by rains. This lessens the danger of rolling clods down on the young shoots and at the same time gives the cane time to get up where it is not so easily disturbed by rolling dirt and clods.

There is no question, but what the continuous passing of implements works the banks down to a considerable extent, but this also takes place nearly to the same extent by the action of the rains and continuous passing of the hoe. And I find it is possible to lay the cane by with practically as good a bank by the use of animal cultivation as by use of hand implements, with the advantage that the cane is layed by with soil in a good state of tilth instead of in a hard baked conditions as when no implements are used.

In districts where (for lack of land) we are forced to put our fields back in cane as soon as the crop is cut, we have considerable difficulty getting rid of the old cane roots; while in the *gran cultura* planting the roots have pretty well disappeared through decay and repeated plowings.

In fields where we are obliged to chop up the stumps in search of the white grub and weevil root-borer, this trouble is done away with; and in fields not treated in this manner, where the old stumps are large and bothersome, we send men in with grub hoes and split up the larger stumps which interfere with the implements.

IMPLEMENTS

After having made a study of this subject for the past four years I have decided on the following implements, which we are now using under different conditions as requirements demand.

I have devised a banking machine, and a disc cultivator with eight discs. In addition to these I use a diverse or spring-tooth cultivator, an ordinary double-shovel cultivator, and small plows.

For conservation of moisture and destruction of small weeds just as they are germinating, I use the spring-tooth cultivator, with levers set so that teeth slant back toward the center of the bank; this has a tendency to draw the mould away from the cane, together with any loose trash and deposite it in the centre of the bank. This is drawn by one animal, and two passes are made; one down the

right side of the bank and back on the left side. We are doing this work now at an expense of 15 cents per acre.

For the destruction of small weeds and building up the bank which may have become flattened out from any cause or other we use the banking machine which is composed of two pieces of sheet iron five feet long set on a slant, with the front ends set apart, the width of the bank and the rear end set just far enough apart to allow the mould to roll out onto the centre of the bank. This is drawn by two good mules, and as this requires only one pass, we pay 8 cents an acre for this work. We find that by passing this implement after cultivation with other implements, we are always able to keep the banks in a satisfactory condition and never lose control of our irrigation water.

After the banker we quite often run the disc cultivator, which leaves a mulch on the sides of the bank next to the cane. When the bank becomes slightly packed as a result of passing these implements, we go in after irrigation with a double-shovel cultivator and make three or four passes as the case may require, and if the bank has become very hard we go in with a small plow and break it up thoroughly, then follow up again with the banker and other implements as the case may require.

It is always desirable, after passing either the small plows or double-shovel cultivator, to pass the diverse or spring-tooth cultivator at once. By this I mean the spring tooth should be in the field at the same time as, and only two or three furrows behind, the small plow or double showel. This will assist materially in conservation of moisture as well as improving condition of soil.

In addition to this system of cultivation, we have introduced in the Guánica dictrict, for the conservation of moisture, and to prevent germination of weeds, the practice, after each of the first three or four irrigations of mulching, or pulverizing the irrigated surface in the bottom of the forrow, both before and after germination, with a tool known in the United States as a potatoe hook—which is a heavy rake of four or five prongs. This operation to be of any material benefit must be done soon after irrigation.

In my opinion, by this treatment of the soil we get considerably more benefit out of our irrigation water, which in the Guánica group constitutes our chief expense.

The foregoing is with reference to our district where (1) we rely principally on our pumps for moisture, (2) where soil is prin-

cipally loose loam and readily adapted to cultivation and very productive with sufficient moisture, (3) where due to pests we do not make a practice of ratooning.

In our other districts where we depend almost entirely on rain, conditions are quite different. The soil for the most part is of a stiff clayey nature, becomes exceedingly hard immediately after rain or irrigation if not properly worked, and has always been considered rather poor in regard to productiveness. And I believe it is on these poor soils where we are deriving greatest benefits from cultivation. A large portion of these lands are farmed in *grand banks*, or in *tableta* of from three to four rows in a *tableta.* Here a greater portion of the year, conservation of moisture is *not* the chief object; but the desired result is to maintain a good soil condition and keep down the weeds, thereby reducing the expense.

However, in accomplishing this we find that where we are able to obtain a good soil condition or mulch before drought, that the cane on these fields comes through the dry weather in good shape and makes some growth instead of drying up and dying back, as in fields not cultivated.

In these fields, where we have to pay more attention to drainage than to irrigation, we make no effort to maintain the bank between the row, and sometimes even bank the dirt on the cane row.

Here also we are never bothered with old cane roots, as land always lies idle a few months giving roots time to rot.

In these districts we ratoon a great deal and start these off by lining trash on every other bank and plow the clean bann with as large a plow as is practical, then trasfer the trash to the plowed bank and plow the other one. In some cases where, due to floods, we are obliged to burn the trash to prevent same being piled on young cane, we go in with a 9-inch plow and three yoke of bulls or three teams of mules and offbar as deeply as possible up close to the cane row. Then we apply fertilizer and either plow this dirt back or work it back with the cultivator.

I am very much in favor of offbarring and believe it should be practiced wherever possible.

In some of these poorer districts we have, through eradication of diseases, introduction of new varieties and cultivation, been able to raise our average yield in tons per acre in the past four years, from 11 and a fraction tons up to an average of 24.6 tons for the crop just finished. Just how much of this increase is to be credited

to cultivation cannot be stated, but there is no question but that cultivation is entitled to a part of it.

Conditions with reference to drought, disease and pests have been so unusual during the past four years, that it has not been possible to compile any positive data regarding the actual advantage to be derived from implement cultivation; and as conditions on different parts of the Island vary so much, any one introducing cultivation with implements has to figure out methods which will apply to his particular conditions.

And while in many instances it may not be practical to introduce a system of intensive cultivation with implements, I am firmly of the belief that in nearly every instance, some implement can be profitably introduced.

WHITE GRUBS, *LACHNOSTERNA* sp., AND LARVAE OF THE WEEVIL ROOT-BORER, *DIAPREPES SPENGLERI* L., ATTACKING SUGAR CANE IN THE GUANICA DISTRICT OF PORTO RICO, AND METHODS PRACTISED FOR CONTROLLING THEM.

By E. H. Barrow,
Assistant Manager of Cultivation, South Porto Rico Sugar Company

Since the Mosaic disease has been reduced during the last two years from between eighty and ninety per cent to one-tenth of one per cent, the most serious menace to sugar-cane growing in the Guánica district is the damage caused by the attacks of white grubs and larvae of the weevil root-borer.

White grubs, *Lachnosterna* sp., have been causing considerable loss in the Guánica district for several years past. These grubs are the larvae of what are known as "May beetles" or brown-back beetles, and eat the roots of the sugar cane and other plants.

These white grubs have been recognized as a serious pest of sugar cane in this district for a number of years and considerable work has been done to try and exterminate them or at least to reduce their number. Reducing their numbers is the only thing that can be hoped for at present and so the work will have to be continued persistently year after year to accomplish it.

The work which has been carried out principally and which is the only possible means as yet known to keep them in check is the collection of grubs and beetles. After the canes are reaped and the trash burned off of the field, the cane stools are plowed out, gangs of men are put into the field to cut the stools in pieces with pick-hoes and collect all the grubs that are found. A careful record is kept of the number of grubs collected and the expenses thereon. The following figures for the past five years may, therefore, be of interest:

Year	No. of grubs	Expenses	Cost per 100
1919	3,055,317	$4,095.48	13.4 cents.
1920	1,745,125	6,003.15	34.4 "
1921	282,452	948.75	34 8 "
1922	926,452	1,196.10	12.9 "
1923 (1)	586,908	835.03	14.2 "

[1] Including 209,311 larvæ of the weevil root-borer.

In the years 1920 and 1921 it will be remembered that the cost of labor was exceedingly high, and for this reason the cost of collection in these two years was over twenty cents per hundred more than that of the other three years, when the cost ranged from 12.9 to 14.2 cents per hundred.

The collection of beetles is carried out every night when they are in flight, generally from April to December in each year. The beetles are found on the cane leaves and on the leaves of most weeds and bushes, and certain trees. A careful record is also kept of these collections and the following are the numbers collected during the past six years:

Year	No. beetles	Expenses	Cost per 100
1918	1,529,225	$720.49	4 7 cents.
1919	1,007,835	524.17	5.2 "
1920	No record		
1921 [1]	248,282	195.55	7.9 "
1922	2,129,985	1,086.88	5.1 "
1923 [2]	1,543,841	621.67	4.0 "

[1] To July 7. [2] To June 7.

For the year 1920 no record was found as to the number of beetles, and so I cannot say if beetles were collected or not that year. In the following year, 1921, collection was only made to July 7, when all work was suspended on the collection owing to the sugar situation that prevailed at that time. This no doubt caused the number of grubs and beetles collected in 1922 to be greater than in the previous year. On referring to the tables it will be noticed that the numbers collected were decreasing up to the date when collection was stopped and began to decrease when collections were again made.

It has been noticed that the beetles emerge in large numbers after rains, and this is perhaps one of the reasons why so many have already been collected this year, as there have been a few showers in this district during the past few months.

From a scientific point of view all grubs and beetles that are to be found should be collected and destroyed, but this is not possible on the practical side, as the cost per hundred has to be taken into consideration. The gangs are therefore increased or decreased in proportion to the numbers that are being found, and in this manner collections are made at the lowest possible figure. In some instances the work is paid for by the number collected, but generally it is done by day labor.

From October 1920, the date that I arrived in Porto Rico, I was constantly on the lookout, and actually made several days' search on different occasions for *Tiphia* wasps, a species of which I knew was keeping white grubs in complete control in a certain disrict in Barbados. It was not, however, until August 1921, nearly a year after my arrival, that I found any of these wasps. Specimens of these were collected and shown to Mr. George N. Wolcott, the Entomologist of the Insular Experiment Station, on his subsequent visit to Santa Rita. Mr. Wolcott was very glad to know that I had discovered these wasps, as several years before he had done considerable work in introducing them into the Island, and, up to that date, none of them had been seen. A paper by Mr. Wolcott on this subject has been recently published in the JOURNAL OF THE DEPARTMENT OF AGRICULTURE AND LABOR OF PORTO RICO, Vol. VI, No. 1. At the suggestion of Mr. Wolcott, specimens were sent to Mr. S. A. Rohwer of the United States National Museum, for identification, who wrote me on October 21, saying, "The three wasps you sent with your letter dated October 7th reached me in good condition. I have examined them and believe they represent a new species of the genus *Tiphia*. This new species is very similar in many ways to some of the species which Mr. Wolcott introduced into Porto Rico several years ago, but I believe it is specially distinct." It cannot, however, be stated that these wasps are parasitising the white grubs, as up to the time of writing no grub has been found parasitised by them.

Various preparations, etc., have been experimented with to try and discover something that could be used against these pests, but nothing has yet been found that would be really useful in combating them.

To give some idea of the loss caused by these pests, it may be of interest to mention an instance. This year canes were reaped from a field, ten acres of which were severely attacked by white grubs. These ten acres yielded only eleven tons of cane per acre while the remaining fifty-seven acres in the field yielded thirty tons of cane per acre, or in other words, nineteen tons of cane per acre more than the attacked canes.

THE WEEVIL ROOT-BORER

The weevil root-borer of the sugar, *Diaprepes spengleri* L, is the va of a small whitish beetle with black stripes. These beetles are

locally known as *vaquitas.* In comparison with the white grubs I consider that they are a more serious pest, as they bore into the root-stock of the cane and thus do more damage and make collection more difficult and expensive. It is also claimed that one borer is capable of killing an entire stool of canes.

They were known to exist in this district for a number of years but no record has been found showing that they were doing any serious damage to the cane. Even the first crop, 1920–21, that I was in the district no serious damage was noticed as caused by them.

In February 1921, however, serious damage was observed as having been done by larvae of the weevil root-borer to canes on a certain field on one of our *haciendas.* The canes on this field of thirty acres were killed and had to be reaped when they were yet quite immature. Needless to say the tonnage was very low and the juice from these canes very poor, only averaging 12.8 per cent sucrose and 70.8 per cent purity. On this field the following work was carried out, which proved to be very effective:

As soon as the canes were reaped, the trash on a portion of the field was burned off and the cane stools ploughed out very carefullly. A gang of men was put to cut the stoools to pieces with pick-hoes, shake the mould off, and place them in small heaps. A cart was then sent along to collect the stools thus prepared and take them away to be burned. The best method of burning these stools was found to be in the following manner: A small heap of trash was made, on which a few pieces of the stools were placed. The trash was then lighted and when a brisk fire was burning more trash and stools were placed alternately in the fire. The main idea is to keep a brisk fire burning and not to place too many stools in it at one time, as the only hope of killing larvae is by having sufficient heat to penetrate the cane to where they have tunneled.

If it is intended to do this work it should be done as soon as possible after the canes have been reaped, for if too long a time elapses, the borers are liable to leave the stools and enter the soil, where it is difficult to find them.

The field was then ploughed and kept free from weeds by ploughing or harrowing each time any weeds started to grow. The idea of keeping all vegetation from the field, was to prevent any beetles that emerged from having any place to hide.

To facilitate the collection of the beetles, pigeon-pea bushes *Cajanus cajan,* are planted around all the fields in this district, as

I discovered in Barbados that great numbers of both of these beetles congregated on them as well as on those of cassava, *Manihot utilissima.* Collections of these weevils are made by day and was first started in March last year. The total collected to the end of December last year were 11,698,000 at a cost not quite four cents per hundred. The largest collection made was the two weeks ending October 26, when over three million were collected. To date this year 4,000,000 have already been collected.

The weevils deposit their eggs on the leaves of the sugar cane and other plants, in small batches and then stick a piece of the same or another leaf over them. The gangs collecting the weevils are instructed to collect these egg-batches also, but, as they are very difficult to find, very few are collected.

Towards the end of February a few acres in a field of *gran cultura* canes, only five months old, were noticed to be drying off. On examination it was found that this was due to the attacks of the weevil root borer. Immediately all of the stools that were so attacked were dug out, the grubs collected and the spaces replanted. The total number of stools dug were 14,572, or just as many as would be in nearly three acres. From these stools 39,674 larvae of the weevil root-borer and 3,003 white grubs were collected. As may be imagined, this part of the field now has a very ragged appearance.

In this piece three plots were marked off and paradichlorobenzine was applied to two of them at the rate of 200 and 400 pounds per acre respectively, and the other plot was left as a check. The plots were examined regularly but in no instance was a dead borer or grub found. The plots to which the applications were made showed no improvement over the check. Further experiments will be carried out with this chemical to see if it can be used with effect.

MOSAIC INVESTIGATION AT CENTRAL CAMBALACHE

PRELIMINARY REPORT

By CARLOS E. CHARDÓN, Commissioner of Agriculture and Labor

The first records of the sugar-cane mosaic in Porto Rico date back to 1915, when Stevenson reported its appearance in the Arecibo valley. It was probably present there a few years because already at that time the infection of the fields was well advanced. In a few years, the epidemic spread, and in 1919 it practically covered all the Island except the isolated valley of Yabucoa. At the present date a great advance has been made in the way of controlling the malady, and while in certain places the "roguing" method has been effective in checking the disease, in others, the displacement of the old "cristalina" and "rayada" types of cane by the immune Uba and the resistant P. O. J. seedlings have been the total salvation of the sugar growers. If conditions favoring the successful exploitation of these immune and resistant varieties would exist all over the Island, then the whole mosaic problem would be satisfactorily solved, but unfortunately, there are important sugar regions in the Island where the Uba cane will not yield a dependable amount of sugar. I am referring to the alluvial soils of the north coast, the valleys of Arecibo, Manatí and la Plata Rivers. These valleys comprise thousands of acres of excellent soil and include the best of the fields of centrals Cambalache, Caños, Plazuela, Monserrate, San Vicente, Carmen and Toa Sugar Company.

Mosaic is more or less widespread in the fields of these seven centrals and it certainly constitutes an important factor in the production of sugar. I know of one of these centrals whose production dropped from 183.00 bags to 87,000 bags in one year, chiefly due to the ravages of the mosaic as it has been cofessed to me by its president. On the supposition that only 50 per cent of that loss is due to the mosaic, and with sugar at $4 a quintal, the loss to that factory alone will amount to $480,000.

It has been stated before that the immune Uba will not yield on these soils a dependable amount of sugar, although it is true that there have been exceptions to the rule; however, in the great majority of

cases, the sugar yield has been disastrous. Dealing with rich, alluvial soils like these, where heavy rains are frequent, it is very doubful whether the Uba will ever be a promising variety here, and consequently the possibility of controlling the mosaic by the use of the immune Uba, is for the present discarded. The P. O. J. seedlings have been tried in the upper portions of the Arecibo valley, especially in central Los Caños. Our sugar technologist, Mr. A. Rosenfeld, has already read a very interesting paper on the behavior of these varieties under Porto Rican conditions. Good results have been accomplished with P. O. J. 36 and P. O. J. 213, and the early maturing P. O. J. 234 is very promising. However, P. O. J. 105, known here as "Egyptian" and which is the most wide-spread of them all, has proven to be rather low in sucrose and a poor ratooner. In fact, the propagation of "Egyptian" cane is not recommended any longer. The other varieties of Java would had been propagated more, had it not been for the spectacular appearance in the Island of the B. H. 10–12 and the S. C. 12/4. The luxuriant vegetation and enormous sugar yield of these two varieties are surprising and they promise to cover a wide area of the Island in the next few years.

The sugar yield of these two varieties, B. H. 10–12 and S. C. 12/4, at Central Cambalache surpasses all previous records and they have been propagated extensively in the Arecibo valley, covering at the present time about 700 acres. In the next two years they will cover practically all the alluvial soils in the Cambalache field. Mosaic, however, has always been prevalent in the Arecibo region and since "rouging" has never been practiced here, the disease is wide-spread in these new fields of B. H. 10–12 and S. C. 12/4, sometimes passing the 80 per cent infection mark. It will be clearly seen that the situation requires deep consideration. It is true that second rattoons of these two varieties have not yet shown any signs of shrinking internodes or canker states. Thus far their behavior has been very satisfactory and somewhat approaching the conditions of the P. O. J. seedlings, which are 100 per cent infected here in Porto Rico, but which do not seem to be affected by the disease. What will be the final outcome of this extensive propagation of infected B. H 10–12 and S. C. 12/4 at Central Cambalache, I am not able to forsee, but at any rate, it is an interesting experiment carried on an enormous scale which promises to be rich in valuable infor-

mation for the sugar men of the world, especially Cuba. If results show that these two varieties are resistant to the disease (somewhat aproaching the P. O. J. seedlings) it will be a great step in advance in the control of mosaic in the Island. If, on the contrary, these varieties fail in the future, then it will be a serious problem to get rid of them and plant again healthy or resistant varieties. If the latter thing happens, the expenses of replacing the field with other varieties will be very heavy, while if on the contrary the former happens, the benefit to the central will be enormous. Which of these two alternatives will ultimately prevail?

I am rather inclined to take an intermediate position. Diseased S. C. 12/4 has been found to suffer in its growth, although no effects of the disease have been found in the canes. A few generations of the disease conditions may affect the cane and consequently, the tonnage. B. H. 10–12 has thus far proven to be little affected by the disease. Whether this variety will ever degenerate or not, I am no able to state now.

No matter what the future results of these varieties will be, it has seemed wise to start nurseries of a great number of varieties of cane and practice "roguing" in order to have at hand sufficient quantity of healthy seed so that in case of a failure of the diseased B. H. 10–12 and S. C. 12/4, new fields of new varieties could be promptly planted. It has seemed that this is a very judicious measure which will only cost a few thousand dollars, but which may be of great help if not the whole salvation, in an emergency case.

While the writer was Sugar Technologist of the Insular Experiment Station there were started a series of field experiments early in 1922, the results of which will be discussed here. Later on, upon my appointment as head of the Department of Agriculture and Labor, Mr. Mariano Mari, an inspector of my department, took immediate direction of the experiments. During my absence they have been conducted with great care by Mr. Mari, who has exhibited great zeal an enthusiasm in the work. I am also under obligation to Mr. Andrés Oliver, president of Central Cambalache, for his hearty coöperation with the Department, and to Mr. José R. Aponte, for the valuable suggestions in connection with the work. Mr. Aponte's experiments with the mosaic since the early days of 1915 have been well known to the sugar planters of that region.

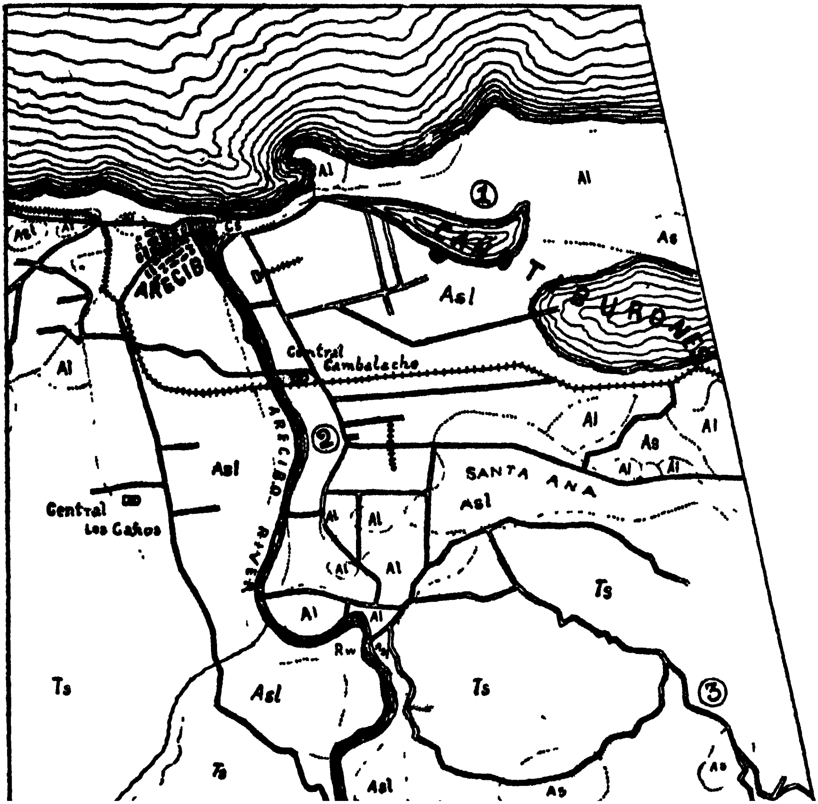
In the Arecibo valley there seem to be conditions favoring the spread of mosaic. In the first place, the soils are low, level and very fertile; cane grows well and it is a well-known fact that mosaic spreads more rapidly in fields where active growth is going on. In the second place, rains are frequent and heavy in certain portions of the year, weeds are very abundant and consequently, conditions are appropriate for the growth and development of *Aphis maidis*. The aphids have been found abundant on grasses in various fields. All these facts explain why it is quite common to find mosaic spreading rapidly in young plantations. With these adverse conditions prevailing, it was very difficult, if not impossible, to select a field for the nurseries where mosaic did not spread from adjoining fields. The selection of these fields for the nurseries needed to be determined with certainty before a large permanent nursery could be started.

In the Annual Report of the Insular Experiment Station for 1221–22, on page 68, the writer pointed out a condition which has later proven to be very helpful in connection with this work. It reads as follows:

"It has been observed that in regions of heavy infection, the percentage of infection in fields near the sea is remarkably low. This fact was very evident in Mayagüez, where fields planted to varieties other than Uba or Swinga, showed over 90 per cent infection or even higher. In a number of fields near the seashore at Guanajibo the mosaic infection was only 10 to 16 per cent, and in one case, a field near the Reform School, was as low as 6 per cent.

"The cause for this low infection is not clear, although the idea has been advanced that the wind from the sea carries particles of salt which are deposited in the leaves, and which serve as repelents against the insects that transmit the disease. It is also possible that the flora of these sandy areas, which are known to be very different from the flora of ordinary cane fields, might lack the necessary host plants of the insects that transmit the disease."

Whatever the cause for this low infection near the seashore may be, the fact is that conditions exist there which are unfavorable to the spread of mosaic. A whole search was made of fields of Cambalache in order to ascertain if this conditions was prevalent there. In this connection the Soil Map, published by the Bureau of Soils in 1902 and which covered a whole strip of soil 20 miles wide from Arecibo, to Ponce, was found very useful, a reproduction of which is here published (fig. 1). Three of its soil types are worth mentioning here:



Soil Map (From "Survey, Bureau of Soils, 1902")

Arecibo loam (Al), which covers portions of the north coast, especially east of Arecibo and bordering Caño Tiburones on the north. It consists of a black, tenacious loam of variable depth with a tenacious yellow loam for subsoil. This soil is considered of poor agricultural value, but bordering Caño Tiburones it is very deep and rich in organic matter, like the *poyales* of the south coast, and with ideal conditions for the planting of cane.

Arecibo silt loam (Asl) comprises the alluvial valley of the Arecibo river and one of the most important agricultural regions of Porto Rico. It is rich brown, silty loam of great depth and uniformity. It is all planted to sugar cane for centrals Cambalache and Los Caños and cover several thousand acres of excellent soil.

. The *Tanama stony loam* (Ts) is a red, tenacious loam which is abundantly found in the terciary *pepino* formation, as a result of the weathering of the original limestone plateau which extended from Martín Peña to Aguadilla and far into the interior of the Island. The soil is rather poor and was all planted to bananas and minor crops, but wherever communications are easy they are now planted to sugar cane.

The percentage of mosaic infection in these three types of soils was found to be very variable. It may be assured that these peculiar conditions are not to be ascribed to the soils themselves, but rather to topographic and climatic condition which affect the rate of secondary infection. Thus the percentage of infection found in fields of the *Arecibo loam* was remarkably low, and thus coinciding with the writer's previous observation along the coast of Guanajibo. On the contrary, the fields in the Tanama stony loam were heavily infected with mosaic, and the only variety which deemed to thrive well here was the D–109. Intremediate conditions were found prevalent in the *Arecibo Silt Loam,* although, as was stated before, the B. H. 10–12 and S. C. 12/4 were heavily infected.

With the purpose of ascertaining experimentally these facts, three fields were selected representing these three types of soils: Field A, in the *Arecibo loam*, Field B, in the *Arecibo silt loam,* and field C. in the *Tanama stony loam.* They were carefully prepared for planting, using the *banco y carril* system, which consists of double rows separated by deep drainage ditches, the holes being 6' mult 5' in the banks. Two seeds were planted in each hole.

The field comprised over half an acre of the *Arecibo loam* type and was a few hundred yards from the shore of Caño Tiburones. It was a black loam with high organic content and excellent for growing cane.

The field was planted to 8 standard varieties of cane from the Insular Experiment Station on March 14, 1923, and harvested December 31, 1923, when the cane was a little over nine months old. The standard variety of that region being Yellow Caledonia, rows this variety were planted alternating with the varieties to be tested. Four plants of each variety were left standing to obtain sucrose mill tests at the end of a year. The results were as follows:

Variety	No. of plants	Diseased	Infection	Field	Sucrose (1)	Purity
Rayada..	70	1	1 42%	24.24 tons	15.03	90.81
D-117.	40	1	2.50%	32 40	13.15	81.67
P. R.-412	136	1	0 72%	38 23	11 58	74 90
P. R.-414	52	2	3 86%	36 54	13 54	81.56
Cristalina.	50	1	2.00%	36.00	15 48	89.22
B-3412.	48	1	2.09%	41 65	12 68	81 80
P. R.-433	34	1	2.94%	44 12	16 87	91.19
S. C. 12/4.	35	2	5.61%	42 85	15 94	90 10
Caledonia.	378	4	1.12%	39 73	13 04	81.42

[1] The sugar tests were made March 28, 1924, by the chemist of Central Cambalache, Mr Román Benítez, with the laboratory hand mill.

The average infection in field I is 1.67 per cent, that is, out of 838 plants only 14 became infected. This is remarkably low, especially if the percentage of infection is compared with those of fields II and III. These results corroborate the idea that regions near the seashore are practically free from mosaic and are consequently ideal for the propagation of selected varieties which are to be extensively used in the field later on.

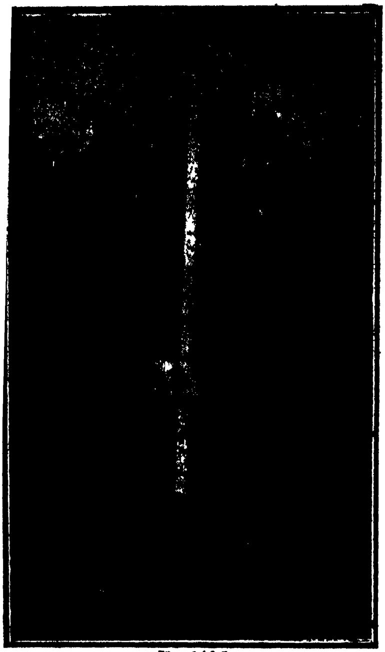
A point of interest which must not be overlooked here is the fact that the variety P. R. 433 surpassed all the others both in yield and sugar content. It has behaved so far, as one of the most promising canes of the P. R. series.

FIELD II

One and a quarter acre of soil, adjoining the Arecibo river on the east bank was selected as the land more suitable to a nursery. It was formerly pasture land, and approaching virgin conditions more than any other place in the whole region. On account of its proximity to the river it was never known to have grown cane before. The soil was a good representation of the well known *vega* lands of Arecibo, the *Arecibo silt loam.*

The field was very well prepared in the usual *banco carril* system but drainage ditches were not found necessary. Twenty-one varieties were brought from the Insular Experiment Station and planted March 15-17, 1923. They well harvested at various intervals from November 21 to December 15 of the same year; that is, barely nine months old. No sucrose tests were made with the varieties, but a careful count of secondary infection was made. Diseased plants were "rogued" out systematically and a complete record

SELECT VARIETIES OF BARBADOS AND DEMERARA



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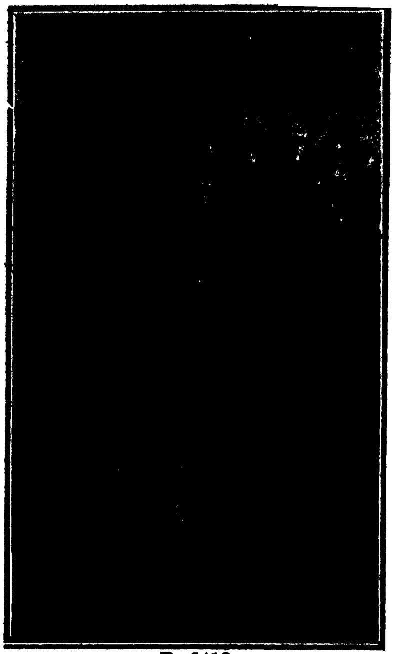

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of the infection of each variety was made. The following results of infection and tonnage were obtained:

Variety	No. of plants	Diseased	Infection	Yield
D-109	60	7	8 75%	48.38 tons
P. R.-662	45	2	3.03%	25.00
P. R.-649	36	9	14.28%	27.77
S. C. 12-4	52	6	5.89%	50.95
P. R.-545	45	8	13.79%	44.09
B. H. 10-12	60	7	9.46%	50.00
B.-3405	66	15	15.62%	54.54
D.-625	42	11	18.96%	45.23
P. R.-329	86	8	7.61%	30.28
P. R.-507	33	1	2.17%	31.25
B.-208	60	16	18.18%	48.33
B.-3412	62	16	16.16%	53.22
P. R.-414	78	7	7.21%	56.92
P. R.-561	86	19	18.09%	60.70
D.-117	65	15	17.24%	43.75
B.-3696	55	8	11.57%	42.59
P. R.-440	67	7	8.75%	53.03
P. R.-328	71	21	16.28%	57.14
P. R.-433	116	13	7.28%	53.10
P. R.-412	73	13	9.92%	47.22
P. R.-492	45	10	16.12%	63.72

Out of 2,103 plants, 219 became infected, or 10.41 per cent. From the above figures it is impossible to deduct the relative resistance of each of the varieties to the mosaic, but it is apparent that there is a great variation in their susceptibility. Much light has been thrown on the question of resistant varieties by the researches of Prof. F. S. Earle. Had not "roguing" been practiced on this field, the percentage of infection would have been much higher, perhaps double or more.

The enormously high yields of many of the above varieties only 9 month old, are due to the high fertility of the soil. Had some of these varieties reached maturity and been allowed to grow for 15 or 16 months, their yield might possibly have established record production for Porto Rico.

The B. H. 10–12 and S. C. 12/4 looked fine, but were exceeded in tonnage by a number of other seedlings P. R. 651, P. R. 328, P. R. 440, and again, P. R. 433 were heavier yielders than B. H. 10–12 and S. C. 12/4, but it is doubtful whether their sucrose content was higher. B–3405 and B–3412 did very well also, but experience elsewhere has shown that they are too late maturing and low in sucrose.

SELECT VARIETIES OF PORTO RICO
(Produced at the Experiment Station, Río Piedras)

P. R. 561

P. R. 662

P. R. 402

P. R. 414

Some of the best varieties are shown in figs. 2 and 3, accompanying this paper.

As a result of this experiment it may be safe to conclude that the *vega* soils of Arecibo are not appropriate for nursery plantings since the plants are very likely to get infected secondarily.

FIELD III

This field comprised about one-tenth of an acre and a place where a former "corral" of cattle was located, was selected. Although the soil was rather poor, being of the characteristic *Tanama stony loam*, it was improved with animal manure. The manure very materially improved the physical texture of the soil.

On March 18, 1923, the following varieties were planted, using healthy seed from the Insular Experiment Station: D-625, P. R. 561, P. R. 328, P. R. 433, D-117, B-3696, P. R. 545, P. R. 417 and P. R. 412. A few cases (6) were noticed in May 25 and the diseased plants pulled out immediately. The next infection was made in June 14, when 69 plants out of 471 were found infected or 14.6 per cent infection. The spread of the disease was so rapid in July and August that it was impossible to keep a record of the infection. In December, about 90 per cent of the plants were infected.

Thus the attempt to establish a nursery in this region of the interior of the Island failed utterly. Variety P. R. 412 completely broke down under the effects of the mosaic. The other varieties were more or less affected.

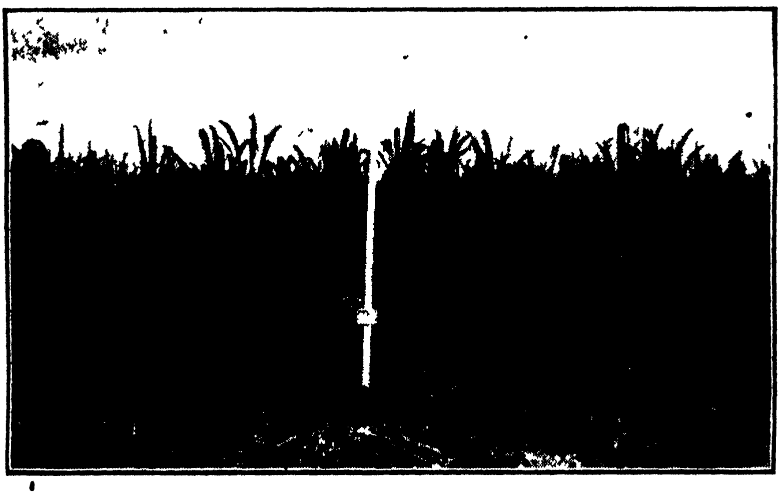
As a result of this convincing test it seems to be hopeless to attempt nurseries in the interior regions of the north coast. Observation has shown that the best variety for this zone is D-109. Uba and the P. O. J. seedlings (with the exception of P. O. J. 105) are heavy yielders here. B. H. 10-12 and S. C. 12-4 do not thrive well under these conditions.

CONCLUSIONS

1. The practice of planting extensively B. H. 10-12 and S. C. 12-4 in the alluvial soils of the north coast of Porto Rico without taking the necessary precautions against mosaic has become a common practice.

2. The yields have increased greatly but a large percentage of the plantations are diseased. These diseased fields do not show any

FAMOUS VARIETIES SANTA CRUZ 12/4 AND HYBRID BARBADOS 10/12



These two varieties, because of the tonnage and sugar yield, are the most favored among our planters.

decrease in production which may be ascribed to mosaic and the ratoons are developing normally and vigorously.

3. It is not known whether these two varieties will in the future exhibit the same degree of resistance that they have shown so far. It seems logical that they will begin to break down in the next few years.

4. Extensive nurseries need to be started in order to have sufficient healthy seed at hand in case there is need of a rapid replacement of the B. H. 10–12 and S. C. 12–4 for other varieties.

5. Experiments in three different regions representing three soil types and three different climatic and topographic conditions disclose the fact that in certain *poyal* lands near the coast the mosaic disease is held in check by unknown adverse condition.

6. These regions seem to be most suitable for establishing the nurseries of different varieties which in the future may meet a disaster or an emergency.

This preliminary report covers only the first year's experience with mosaic at Central Cambalache. Following conclusion No. 6 above stated, a large nursery of 26 acres comprising 52 varieties was planted north of Caño Tiburones, adjoining former field I. The results of the second year's experience will be published later, but as a matter of information it may be said that the percentage of infection in these 26 acres has been so far only 0.43 per cent. These results from the second year's experience show that it is safe to propagate varieties on a large scale in this region.

The benefit which may be derived by the central from these 26 acres of healthy seed is something which the future will decide. Will it be a worthless expenditure of money or will it turn out to be a deciding factor in the years to come?

AN INTERESTING CASE OF BOILER-TUBE CORROSION

By F. López Domínguez and R. Fernández García,
Chief and Associate Chemists, respectively, Insular Experiment Station

In the month of February of the present year, the Insular Experiment Station was informed by the manager of one of the sugar factories of the Island that an unusual corrosion had been taking place in their boiler tubes and that so far they had been unable to find the cause for it, or an appropriate method for its control. They requested, therefore, that the case be investigated by the Station.

Complying with orders of the Director we proceeded in his company to visit the factory, where the following information was obtained:

1. For fourteen years they had been using to feed their boilers, which are of the fire-tube type, water from a stream flownig by the factory, mixed with condensation water from the evaporators, and for the boilers of the locomotives, water from the stream exclusively.

2. The observation was made that there were incrustations left by these waters, and to prevent this they decided to cover the tubes of the factory boilers with graphite paint. This practice was begun in the year 1917.

3. By the end of 1923 on inspecting the factory boiler tubes, some of them were found to be badly corroded; new tubes were then substituted for these corroded tubes.

4. Shortly after the beginning of the 1924 crop a very rapid corrosion of the tubes was noticed. This went to such an extreme that a new set of tubes was ordered from the States. They estimated the expenses incurred on account of this trouble, including the new order for tubes, at $20,000.

5. The tubes of the locomotive boilers, on the other hand, in which only stream water was used, showed no sign of corrosion but, on the contrary, they were found to be covered with a thick crust of mineral residues. On first consideration of the problem, then it looked as if the corrosion might be due to acidity in the condensation waters, since the water from the stream was capable of forming incrustations. With this idea in mind, we proceeded to take samples of the condensation waters from the evaporators and from the feeding tanks as well as from boilers 1 and 3, the only ones containing water

which had not been changed for the last 24 hours. As additional sources of information we also took samples of the waters from the stream and of the crust found in the tubes of the locomotive boilers.

The water samples from the boilers were of a dark color with a green tinge, and contained black particles in suspension. It was in explanation of this that we were informed that graphite paint had been used in the tubes and that this was the cause of the color of the water.

The samples were brought to the laboratory and the following tests were made:

1. Alpha naphtol tests for sugars in the condensation waters and in the water from the feeding tank. All tests negative.

2. Acidity in 10 cc. of water:

Boiler No. 1	9.1 cc. of n/100 Na OH
Boiler No. 3	30.5 cc. of n/100 Na OH
Quadruple effect	Clean transparent water without traces of oil
Evaporator No. 1	0.54 cc. of n/100 Na OH
Evaporator No. 2	0.22 cc. of n/100 Na OH
Evaporators Nos. 2, 3, 4 mixed	0.35 cc. of n/100 Na OH
Feeding tank	0.84 cc. without traces of oil

3. Iron in solution in parts per million:

Boiler No. 1	0.216 cc. Fe_2O_3
Boiler No. 3	0.264 cc. Fe_2O_3

4. Analysis of water from the stream:

Loss on ignition	102.0 parts per million
Bicarbonates HCO_3'	103.1 parts per million
Sulphates SO_4''	6.5 parts per million
Chlorides Cl	18.7 parts per million
Sodium Na'	18.8 parts per million
Calcium Ca''	14.7 parts per million
Magnesium Mg''	4.1 parts per million
Aluminium Al_2O_3	4.0 parts per million
Silica $Si O_2$	34.1 parts per million

5. Incrustation from the locomotive boilers:

Qualitative analysis: Iron, calcium, aluminium, magnesium and silicon present.

The foregoing data show:

1. That there was no sugar going to the boilers in the condensation waters.

2. That the acidity found in the water of the evaporators was too small to account for the trouble observed, inasmuh as the accumulation of acids was avoided by frequently changing the water of the boilers. Notice, however, that the acidity is greater in the feeding tank and greater in evaporator No. 1 than in the rest. This shows that there were acids going into evaporator No. 1 as well as into the feeding tank carried there by the exhaust steam; but in proportion, however, as will be seen later, much lower than those found in the boilers.

3. Boiler No. 3 showed an acidity three times as great as Boiler No. 1, which shows that the cause whatever it might be, was acting with greater intensity in Boiler No. 3. This is confirmed by the figures found for the iron content of the boiler waters, which was higher in the case of the samples taken from Boiler No. 3.

The analysis of the stream water as well as the examination of the locomotive incrustations shows what we already suspected, that this water was not capable of causing corrosion.

It has been proven, then, that the corrosion was not due either to the condensation waters or to the stream water, and we therefore were compelled to give up our first theory that the corrosive agent might be taken to the boilers by the feeding waters. We were then forced to the conclusion that the cause was in the boilers themselves.

Looking then for another explanations of the facts, we remembered that the boiler waters, on being shaken, formed a great deal of foam which stayed for a long a time and had the appearance of soap suds. This gave us the key to the situation. What could be the cause of the foam? There were not enough alcaline salts in solution to account for its formation, as on the contrary the waters were acid. Was there any soap in dissolution? How could the soap get there? There was a possibility. If the paint used in the tubes had been prepared with a vegetable fat, these might very well be partly saponified by the bicarbonates of the stream water. Then we remembered that linseed oil is very frequently used in the preparation of graphite paint. If this was so, we ought to be able to find in the water from the boilers the products of decomposition of linseed oil and, furthermore, they should be fatty acids capable of dissolving iron under the condition of the boilers. With references to this possible decomposition says Fox, referring to the alterations undergone by linseed oil on being subjected to boiling temperature,[1] "the oxi-

[1] Allen Comm Organic Analysis Vol 11, page 844, Fourth Edition.

dation products are formed from the acids and the glycerol is decomposed into acids of the acrylic series, forming the irritating vapors which always accompany oil boiling. Acetic and formic acids are prominent constitutents of these vapors, and carbon dioxide and water are also present.'' To verify this theory we visited again the factory to get new samples and to obtain more information. On questioning the engineer, we were informed that the graphite paint had been prepared of late, some times with mineral oils and some times with linseed oil. We were also informed that boiler No. 3 had been painted this year when the tubes were changed, and that boiler No. 1 had been painted for the last time the previous year. We were as well informed that the live steam from the boilers on condensing in the low places of the steam pipes, caused corrosion.

We proceeded to take samples of the water from the boiler No. 3 and of the linseed oil and graphite used in the preparation of the paint.

The linseed oil was tested for acidity as follows:

3. cc. of oil were mixed with 300 cc. of water and the mixture shaken at intrevals for an hour. At the end of this time 25 cc. of the mixture were titrated with n/100 Na OH after the mixture had been filtered. In the same manner portions of 25 cc. each were titrated two days, four days, and six days later respectively. The results were as follows:

After one hour	0.33 cc. N/100 Na OH
Two days after	0.73 cc. N/100 Na OH
Four days after	1.47 cc. N/100 Na OH
Six days after	2.88 cc. N/100 Na OH

The oil as may be seen, contained free acids, which entered in solution almost in direct portion to the time of contact between the oil and the water. This rather indicates a process of hydrolysis. In the waters of the boilers, tests were made for acetic acid by the acetic-ester method and for formic acid by the reduction of silver nitrate; both tests were positive. As a direct proof we undertook to study the behavior of the linseed oil under the conditions existing in the boilers, duplicating these as far as possible in the laboratory. Accordingly, we heated for 5 hours in an autoclave under 30 pounds pressure in closed bottles the following mixtures:

1. 300 cc. distilled water plus 3 cc. oil
2. 300 cc. distilled water plus 3 cc. oil plus 1 gram graphite
3. 300 cc. distilled water plus 3 cc. oil plus 3 grams iron

4. 300 cc. distilled water plus 3 cc. oil plus 3 grams iron plus 1 graphite
5. 300 cc. stream water plus 3 cc. oil plus 3 grams iron
6. 300 cc. distilled water plus 6 cc. oil

These mixtures were filtered after being taken out of the autoclave and the filtrates were tested for acidity and for iron. In all cases in which iron was added, a positive test was given by the filtrate for this element. The titrations were as follows:

1. 25 cc. filtrate	3.59 cc. n/100 Na OH
2. 25 cc. filtrate	3.48 cc. n/100 Na OH
3. 25 cc. filtrate	3.37 cc. n/100 Na OH
4. 25 cc. filtrate	3.70 cc. n/100 Na OH
5. 25 cc. filtrate	3.33 cc. n/100 Na OH
6. 25 cc. filtrate	6.30 cc. n/100 Na OH

In filtrate No. 6 positive tests were obtained for acetic and formic acids. These new data prove the presence of the products of decomposition of linseed oil in the boiler waters, as positive tests for these products were obtained both in the samples taken from the boilers and in the mixtures prepared and heated under pressure at the laboratory.

It was further proved that the acids formed were capable of dissolving iron, as was seen by the positive tests for this metal obtained in the filtrates of the mixtures containing this element. Notice again that the acidity of flasks 1, 2, 3, and 4 with distilled water and 3cc. of oil each, were far nearly the same, whereas the filtrate from test No. 6 with a double amount of acid contained an acidity which was practically twice as great. In flask No. 5, in which stream water was used, the acidity was much lower, showing that part of the acids had been saponified by the bicarbonates present in the waters. In regard to this it should not be forgotten that boiler No. 3, recently painted, was the one which presented the highest acidity; this may be explained by the fact that it contained more oil than boiler No. 1, which was painted the year before.

The higher acid content of evaporator body No. 1 and of the feeding tank are also explained, as the volatile acids formed in the boilers would pass to the steam pipe and would be carried over by the steam after going through the cylinders of the engines to the *calandria* of the first body of the evaporator. This acidity of the live steam is demonstrated by the corrosion which it produced in the steam pipe and the valves.

The possibility of the exhaust steam pipes carrying vegetable

oils washed from the cylinders as the possible cause of the acidity noticed, did not escape our attention; but upon inquiry from the factory engineer we were assured that all the lubricants used in the factory were of a mineral nature.

Accordingly, we considered it unneccessary to investigate this point further, chiefly when the sample of the condensation waters from the *calandria* of the first body of the evaporator was very clear and did not present any signs of oil. Having satisfied ourselves that the corrosion in this case was due to acids produced by the decomposition of the linseed oil used in the preparation of the paint applied to the boiler tubes, we recommended that as soon as the factory made a stop these tubes should be washed with a boiling solution of caustic soda and in the meantime that lime should be used in the feeding waters to neutralize the acidity in the boilers. This, we were informed, the factory engineer had begun to do. Also that on installing the new tubes the paint should be prepared with a mineral oil. The above discussion may be summarized as follows:

1. Upon testing the stream water and the condensation water, sources from which the feed water was supplied to the boilers, no corrosive agents were formed which could account for the trouble observed. It was evident, then, that the cause was in the boilers themselves.

2. Upon testing the boilers' waters they were found to contain a very high acidity as well as considerable amounts of iron in solution. It was also noticed that they formed a foam which very much resembled soap suds. This led us to believe that the graphite used to cover the boiler tubes had been prepared with a vegetable fat, probably linseed oil.

3. On investigating the kind of acids found in these boiler waters, they were found to be organic acids (acetic and formic). On inquiry from the factory engineer, we were informed that linseed oil had been used.

4. To verify our conclusions we duplicated as much as possible in the laboratory the conditions which we supposed had existed in the boilers, heating under pressure mixtures of water and linseed oil; water, linseed oil and iron; water, linseed oil, iron and graphite In every case we have obtained the formation of organic acids of the same nature as those found in the boiler waters, and in every

case in which iron was present in the mixture a positive test was obtained for this metal in the filtrates from the solutions.

5. The recommendation was made that the lime be used in the feed water, to neutralize the acidity in the boilers; that the tubes be washed with boiling caustic soda solution to remove the paint, as soon as the factory made a stop, and that when new tubes were installed the paint be prepared with kerosene oil.

DETERMINATION OF MACERATION PER CENT OF CANE AND THE PERCENTAGES OF FIBRE AND SUCROSE IN CANE

By JOSÉ J. ACOSTA, Factory Superintendent, Central "Juncos"

The well-known difficulties experienced in obtaining a representative sample of the cane ground in a sugar factory make it inconvenient to determine the percentage of fibre and sucrose in cane by direct analysis of the latter, and accordingly, these items are estimated from the data of juice and bagasse analysis, and the weights of cane, mixed juice, and water of maceration.

Sucrose in cane is equal to the sum of sucrose in mixed juice and sucrose lost in baggase. The sucrose in mixed juice is easily obtained from the weight and analysis of said juice; but the sucrose lost finding the weight of the water of maceration. Factories under these conditions can use only one method for calculating percent fibre and sucrose in cane. This method is clearly explained on page 553 of the last edition of Noel Dee's "Cane Sugar."

The following data are daily obtained in these factories:

$C =$ Tons of Cane ground
$G.\,M. =$ Tons of Mixed Juice extracted
$B^m =$ Brix of Mixed Juice extracted
$B^n =$ Brix of Normal Juice
$B^b =$ Brix in bagasse per cent bagasse, obtained by dividing the per cent sucrose in bagasse by the purity of juice from the last roll
$F\,\%\,B =$ Fibre per cent bagasse obtained from the per cent moisture in bagasse and Brix in Bagasse per cent Bagasse.

If T. F. represents the tons of fibre in cane we have:

$C - T.\,F. =$ Tons of normal juice in cane.
$(C - T.\,F.)\ B^n =$ Tons of Brix in cane. Also the Tons of Brix in cane is equal to the sum of Tons of Brix in mixed juice and Tons of Brix in Bagasse.

Then:

$$(C - T.\,F.)\ B^n = G.\,M. \times B^m + \frac{B \times F}{T.\,F.} B^b; \text{ or, } C \times B^n$$

$$+ T.\,F. \times B^n = G.\,M. \times B^m + \frac{T.\,F. \times B^b}{F\,\%\,B}$$

Transposing:

$$\frac{T.F. \times B^b}{F \% B} + T.F. \times B^n = C \times B^n - G.M. \times B^m$$

$$T.F. = \frac{(C \times B^n - G.M. \times B^m)\ F \% B}{B^n \times F \% B + B^b}$$

Knowing T. F. or the tons of fibre in cane, the weight of bagasse is determined.

$$\text{Tons of Bagasse} = \frac{T.F. \times 100}{F \% B}$$

We have been using this method for determining percent fibre and sucrose in cane.

Commonly a factor or coefficient is used either to multiply or divide the percent dilution so as to obtain the percent of maceration Most of the chemists in Porto Rico divide by 0.85 while others multiply by 1.1669.

As Noel Deer's method is so logical, and the factor or coefficient method so inaccurate, we believe the former method is more exact.

It is argued that the factor for calculating maceration or dilution is carefully determined using sensitive and exact water meters.

We believe that it is a dangerous procedure to assume that a factor obtained while a certain variety of cane, that may be of either plant or rattoon crop and of a given age, in mills adjusted for the occasion and revolving at a certain lineal velocity, should be taken as true for all canes and all conditions of the mill. It is still more dangerous to apply such factor to another mill or another factory.

Suppose all these variables do not affect the ratio $\frac{\text{Dilution}}{\text{Maceration}}$; or in other words, suppose that cane and mill conditions be the same; then, it would not be right to take this ratio as constant when in fact it varies when the amount of maceration is varied.

The coefficient method in vogue implies that the quantity of water retained by the bagasse varies with the quantity of maceration used. We are contrary to this belief, for if cane and mill conditions are constant, the quantity of water retained or absorbed by the bagasse is constant when maceration exceeds a determined minimum. Maceration can be diminished to a point where the mill would not extract the added water; thus allowing it to pass entirely to the bagasse.

Representing maceration by *m* and the quantity of water re-

tained by bagasse by c, a constant, we have that dilution is m–c and $\frac{\text{dilution}}{\text{maceration}} = \frac{m-c}{m}$ It is obvious that this term, far from being a constant, is a variable and varies directly with m while changing the quantity of maceration.

We installed this year at Central Juncos a General Electric flow-meter for measuring maceration water, and although the meter did not work constantly, we had opportunity to check the results obtained with Noel Deer's formula at such times as the meter was working right.

We must insist in the installation of scales for weighing the maceration water. I say scales, because the meters in spite of being exact when they work right, get stuck frequently and cannot be depended upon for continuous work. I beg to recommend the use of Noel Deer's formula when a scale is not available so as to obtain uniform and comparative results in different factories.

Let us not be satisfied with weighing the canes and the juice only; let us weigh also the water of maceration so as to eliminate from our reports the extraction and analysis of the imaginary normal juice, and be able to abolish the use of factors, rather doubtful, and the use of formulae which increase unavoidable errors. In this way we could come closer to the real sucrose per cent in cane—the most important factor given in a laboratory report on which to base judgment on the work done in a factory.

PRESENT KNOWLEDGE OF MOSAIC DISEASES

By MELVILLE T. COOK, Pathologist, Insular Experiment Station

The mosaic diseases of plants have become very prominent within the past few years. No doubt these diseases have existed for many years but they may not have been so widely distributed or so destructive as within recent years. Certainly no group of plant diseases known to modern science have proved so mysterious or so difficult to control as these "mosaic" diseases. In fact the causes are as yet unknown unless the recent studies to which I shall refer prove to be an open door to this phase of the subject.

A number of terms have been used to designate the disease which is now so generally known as "mosaic". This term has come into very general use because it is in itself descriptive of the diseased plants. Another type of disease which appears to be of the same general character but which does not show the markings is known as "yellows". However, this term is not so descriptive because diseased plants are not always yellow and because the term "yellows" is applied to some diseases which are caused by fungi. "Curly leaf" of beet, "leaf roll" of potato and some other diseases are probably similar in character to the mosaic disease.

Although these diseases did not attract much attention until within the last quarter of a century, they have no doubt been important factors in plant production for a very long time. Unfortunately, some of the early descriptions are of such character as to leave us in doubt as to the disease in question. However, some of them are sufficiently definite to lead us to believe that "peach yellows" was known to the growers as early as 1797. Swieten mentions a disease of tobacco which was probably "mosaic" in 1857 and which was known for some time as "rost" or "Fleckenkrankheit". This appears to be the first definite record of a mosaic disease on any plant. The "mosaic" disease of tobacco was studied by Adolf Mayer in 1885 and he gave it the name of "mosaic". For many years, tobacco mosaic occupied the centre of the stage, but the discoveries of mosaic in other plants and its recognition as a very severe disease on many crops, such as sugar cane, potatoes and tomatoes, have directed our studies along broader lines.

The "mosaic" of sugar cane was reported from Java in 1890 under the name of "*gele strepenziekte*" or "yellow Stripe". In 1909 it was reported from Egypt on cane imported from Java. In

1910 it was reported from Hawaii. It was first reported from Porto Rico in 1916 and its spread and destructive characters are so well known that it is not necessary for me to discuss them at this time.

In fact it is the purpose of this paper to give a review of our knowledge of mosaic diseases in general, with special attention to the cane mosaic. A paper by Commissioner Carlos E. Chardón on this same general subject was published in *Revista de Agricultura de Puerto Rico* in October 1922, but it was considered advisable by both Mr. Chardón and the speaker to present the subject again at this time.

The cause of the disease is the question which is uppermost in the minds of all observers. We will give a brief discussion of the theories which have been advanced from time to time.

1. *Bud variation theory.*—It is well known that many species of plants are subject to very great variations, both through the seeds and through the buds. In fact it is through the selection of the most desirable variations that we have obtained many of our most valuable cultivated plants. Sugar cane is very generally known as a plant subject to many variations. The Dutch scientific workers in Java who were the first to report mosaic of the sugar cane, having failed to transmit the disease by means of artificial inoculation, came to the conclusion that it was not a disease in the usual sence of the term but a bud variation. However, they recognized that these supposed bud variations, which were in reality cases of mosaic, were undesirable. Therefore, they made an effort to get rid of them and unconsciously practiced elimination of the diseased or undesirable plants and the selection of the resistant varieties.

2. *The soil theory.*—The influence of the different kinds of soil and fertilizers on plant growth is so very generally recognized that many people very naturally took in that direction for the explanation of both good and evil. The results of studies on this line have been such that it is now very generally recognized that the causal agency does not lie in the soil or in the use of fertilizers.

3. *The bacterial theory.*—The rise of bacteriology by which so many diseases were explained very naturally led many to believe that this important science would give us the key to this disease. The idea that bacteria were the cause of the mosaic of tobacco was first advanced by Mayer (1886). This theory was supported by Iwanowski (1892) (1901) (1903); Prillieux and Delacroix (1894); by Marchal (1897); by Koning (1899, 1900); by Breda van Haan

1899); by Behrens (1896); by Hunger and others. Some of these workers obtained and described what they believe to be the causal organism. Unfortunately, no definite proof was obtained.

4. *Protozoa theory.*—Although the bacterial theory has not been proven there are many who believed that these diseases might be due to an organism with a life cycle somewhat similar to that of the organisms causing the yellow and malarial fevers.

In 1903 Iwanowski found bodies which he thought might be the cause of the mosaic in tobacco, but no proof was forthcoming and his work did not attract much attention until recently. In 1919, Matz found what he at first claimed to be an organism in mosaic sugar cane in Porto Rico, but he later found reason for doubting his first claims. In 1921 Kunkel reported the finding of protozoan-like bodies in corn mosaic and later in cane mosaic. It was thought that these bodies might possibly be the cause of the disease but as yet there is no definite proof. In 1922(?) Nelson reported the finding of protozoan-like or trypanosomelike bodies in tomato and other plants infected with mosaic. Later studies show that similar bodies are to be found in apparently healthy tissues.

In 1923, McKinney, Eckerson and Webb reported the finding of bodies in wheat rosette and mottled wheat. The speaker has been making studies on sugar cane in Porto Rico along similar lines as the studies of Iwanowski, Kunkel, Nelson, McKinley, Eckerson and Webb. Bodies similar to those reported by these workers have been found. There are also certain other very pronounced differences between the cells from normal and diseased cane. Whether these bodies which have been reported are the causes of disease or the results of the disease is a problem which is as yet unsolved.

5. *The physiological theory.*—This was at one time more generally accepted than any other theory. It was developed in connection with the study of the tobacco mosaic. Sturgis in 1899 expressed the belief that the disease might be due to injuries or to soil and atmospheric agencies. Hunger (1903, 1905) stated that it was due to a disturbed metabolism which might be the result of metereological or soil conditions. Westerdijk (1910) called attention to certain data indicating that it might be due to intensity of light.

While it is very doubtful if the cause is to be found in the soil, temperature, light or moisture, the study of these factors must not be neglected. Even though they may not be the causal agents they may influence the severity of the disease.

The causes of wheat rosette and wheat mottle, whatever they may be, are said to persist in the soil. Temperature is an influential factor in potato mosaic and there is evidence to indicate that moisture is an influential factor in cane mosaic. All of these factors must be studied in connection with cane mosaic.

6. *The enzyme theory.*—This theory was adhered to by Woods and others and was closely associated with the physiological theory. This theory as briefly stated by Woods is: "The disease is not due to parasites of any kind, but is the result of defective nutrition of the young dividing and rapidly growing cells, due to a lack of elaborated nitrogenous reserve food accompanied by an abnormal increase in activity of oxidizing enzyme in the diseased sells." Woods also found an excessive accumulation of starch in the diseased plants and a defective translocation of same. He believed that the excessive amount of oxidases inhibited the diastatic action on the starch and thus resulted in its excessive accumulation. The excessive accumulation of starch and reduced translocation was demonstrated for "peach yellows" by the speaker and the results published in the *Botanical Gazette,* but this does not prove that the enzyme theory is correct. The speaker is now making similar studies on the sugar cane. The studies up to this time indicate some very interesting physiological disturbances, especially in connection with the photo-synthetic and metabolic activities of the plant. In brief, I may say that from the physiologic standpoint cane mosaic is "starvation" due to disturbed photosynthetic and metabolic activities. The cause of these disturbances are problems for further investigation.

7. *The virus theory.*—This theory was advanced by Beijerinck (1898), who had previously held to the bacterial theory. It explained the mosaic as due to a "*contagium vivium fluidum*" or contageous living fluid which was soluble, diffusible, living and capable of increasing in amount. This theory has been accepted by many and has been the basis of a considerable amount of research. This is still a fruitful line of study which is being followed in some places.

Regardless of cause it is very evident that the mosaic diseases can be transmitted from plant to plant. In the case of some plants, of which the tobacco is a notable example, the disease can be transmitted by contact or even by the handling of diseased and then healthy plants. In some cases it can be transmitted by pruning and in some cases by inoculation. In a number of cases it has been demonstrated that the mosaic diseases are carried from diseased to healthy plants

by insects. In the case of the sugar-cane mosaic successful work on this line has been carried on by Brandes, Ledeboer, Bruner, Kunkel, Chardón and Veve. In some few cases there is evidence to indicate that the disease can be transmitted between plants of different species. It has also been demonstrated that the mosaic disease of some plants may be carried by plants of an entirely different species without showing it.

PRESENT STATUS

Our knowledge of mosaic diseases in general may be summarized as follows:

1. Mosaic is a term applied to diseases of plants which cause a mottling or striping of the foliage.

2. This disease also frequently causes a dwarfing of the plant and sometimes reduction of certain parts.

3. Some of the diseases known as "yellows", "curly leaf", "leaf roll", etc., are very similar in nature to the mosaics.

4. The disease in many plants is transmitted by insects.

5. The disease on cane spreads most readily during wet weather.

6. The cause of the disease is not definitely known.

7. Recent studies by Kunkel indicate that diseased plants may recover.

8. The disease may be carried on apparently healthy plants and sometimes in plants of entirely different species.

9. There is some evidence to indicate that the disease may be due to an organism.

Future lines of work are as follows:

1. More extensive and exact field studies to determine susceptibility, of varieties, spread, effects of soil, cultivation, character of seed, etc. These studies will require a long period of time.

2. Histological studies to determine possible cause and effects on the plants.

3. Physiological studies to determine the effects of soil, fertilizers, temperature, light, moisture and other factors on the disease.

4. Studies on transmission to determine the insect carriers and their life histories. Also the extent to which the disease is carried in other species of plants. Also to determine the possiblity of its being carried in supposedly immune varieties.

5. There is no evidence that any of the mosaic diseases are caused by soil conditions or can be transmitted through the soil, although the mottle disease of wheat is said to persist in the soil.

SUGAR-CANE LEAF SPOTS IN PORTO RICO

By MELVILLE T. COOK, Pathologist, Insular Experiment Station

The leaf-spot diseases of sugar cane are very abundant and conspicuous and undoubtedly cause far more losses than are attributed to them. In fact, they are so common that we have neglected to give them the proper attention.

These spots, with the exception of the mosaic, are very generally caused by fungi, and the most abundant leaf spots in Porto Rico are caused by *Leptosphaeria sacchari* and *Helminthosporium sacchari.*

When the writer first came to Porto Rico in July 1923, his attention was called to two apparently new leaf-spot diseases which were causing considerable alarm among the sugar-cane growers.. One which was found at Manatí and later at other points along the north coast was temporarily designated as the "Manatí disease". It was most severe on D–109 but has also been found on D–117, B–3412, F. C. 214, D–433, P. R. 260, P. R. 430, S. C. (12) 4, P. R. 561, P. R. 412. The other was found at Santa Rita only and on B. H. 10(12). It was temporarily designated as the "Santa Rita disease". It has since been found on some other varieties. Their disease may be described as follows:

MANATÍ DISEASE

This disease starts as very small reddish, occasionally black spots. If red, a black centre develops very quickly. The spot becomes very much elongated but usually remains narrow. The centre is surrounded by a yellowish zone which may be light green or almost white. These colors grade or blend into each other and vary greatly in relative amounts. Some of the spot remains red until one-fourth inch in length before showing the black center. Any one of the three colors may predominate. When the spots grow old, they usually develop ashy-colored centers. They vary greatly in length from one-fourth inch to 3 inches or more. Occasionally they form reddish or dark-reddish stripes extending from base to tip of leaf, but these are probably the results of the unions of two or more spots. In the young spots the colors are usually bright and clear, but as the spots grow old the colors become dull and gradually disappear with the dying of the leaf. The spots may appear on any part of the

leaf from midrib to margin but do not occur on the midrib. They are much less severe on the sheath than on the blade. In severe cases the entire leaf with exception of the midrid is practically covered with these spots. The result is the death of the infected part and checking of the growth of the plant.

The sporophores are in clusters of from four to twenty, unbranched, 3–10 septate, dark green to brown or black, only slightly geniculate, 25 to 115 × 5 u. spore slightly curved, 5 to 11 septate, 45—110×12 u.

SANTA RITA DISEASE

This disease starts with minute reddish spots. As they advance, they may occasionally assume the same characters as those of the Manatí disease but usually are wider, blunt with very pronounced red color which gradually becomes more or less purple. In more advanced stages the spots are large and irregular in shape. This irregularity is apparently the result of the union of both old and young spots. The results is that the spots become very large and irregular in shape and sometimes include small spots of apparently healthy tissues. They may now, be more appropriately called blotches. The color varies from red to dark purple, the latter color predominating. The surrounding tissue is usually pale yellow. The amount of purple blotches increases until it is far in excess of the green on the lower half of the leaf. The upper or outer half of the leaf shows very little or no spotting, but with the advancement of the disease on the lower half it becomes yellow and ashy brown. The sheath is finally attacked but not until the disease is well advanced on the blade. The result is a checking of the growth of the cane.

The sporophores are in clusters of from 3 to 6, unbranched, 6–10 septate, dark green to brown or black, straight or geniculate, bearing a single spore at each bend, 60–300×12–14 u. spores slightly curved, 4–10 septate, 30–95×12–15 u.

The preliminary studies did not show any considerable number of spores, but later it was found possible to secure the spores in great abundance.

The Manatí disease is very similar to *H. sacchari* as described by Butler in India (1913) which is probably the same *Cercospora sacchari* which was described by J. Van Breda de Haan from Jnva (1892) and by Cobb from Hawaii (1909). The Santa Rita disease shows greatre differences and may possibly be a new variety or a

new species. However, it may be that the peculiar blotching may be due to an entirely different cause or to a combination of causes. The studies of the speaker on the Santa Rita disease, have been carried on at considerable disadvantage.

Inoculation studies have been conducted with these two diseases on D–109 and B. H. 10(12). Both varieties are easily infected by either fungus, and in the young stages it is difficult to distinguish the two diseases, but in advanced stages the characters are more prominent.

As previously stated, the "Santa Rita disease" appears to be restricted almost entirely to the one variety and to the one locality on the Island. The "Manatí disease" varies in severity, locality, variety and humidity. In some cases it is no doubt the cause of heavy losses. It is very important that we make more extensive studies on these and other leaf spots to determine the susceptibility of varieties and the influence of environmental factors. In recognition of the importance of this work the Commissioner and the Director have authorized the installation of a small overhead irrigation system which will make it possible to pursue these studies.

These leaf-spot diseases may be taken as an index of what we are to expect in the way of plant diseases. The introduction of varieties of sugar cane from one part of the world to other parts means the carrying of diseases. A disease which may be of no imporance in one part of the world may become virulent in another part. In the development of new varieties these diseases must be taken into consideration. New varieties which possess the characters desired by the grower may not be resistant to disease. Finally, it must be remembered that the same laws which make possible the development of new varieties of sugar cane may also lead to the development of new strains of injurious fungi.

SOME NOTES ON TILE DRAINAGE ON THE SOUTH COAST OF PORTO RICO

By G. M. GILES, Manager, Central Mercedita

The use of tile drains in Porto Rico was first attempted, so far as the writer knows, at the Mayagüez Experiment Station some eight or ten years ago.

In 1921 while visiting that station a field was pointed out as having been drained several years previously. The drainage was so successful as to convert what had been a lagoon in wet weather, and a swamply soil in dry spells, into a fertile field which was planted to cane and was being cultivated by a wheeled cultivator drawn by mules.

This experience seemed worth emulating and it was decided to try similar work at Mercedita where there are numerous wet spots in many fields. These spots are for the most part salty as well as wet, due to the evaporation of excess irrigation water which is more or less charged with salts from the alkaline soils in the neighborhood.

On investigation it appeared that drain tile made in the States could not be imported at reasonable cost on account of excessive breakage. A hand-power machine was therefore secured for making tile from cement mortar. These machines are inexpensive and after a little practice an ordinary laborer with one helper can make from 250 to 350 tiles per day.

The mortar used is three-to-one mixture, and one bag of cement should make about 75 tiles four inches in diameter and one foot long.

After curing ten days or two weeks the tile can be handled and hauled to the field with but nominal breakage.

The depth and spacing of drains is a matter for experiment In very wet impervious soils we have sometimes placed drains only 12½ feet apart. This was in low *poyal* land where the outlet was only 2½ feet lower than the surface of the field. In more favorable circumstances drains 100 feet apart and 3½ to 4½ below the surface have been satisfactory. Not infrequently the depth and spacing vary considerably in the same field, owing to the difference in soil and in the amount of water to be removed.

It has been our practice to cover tile, which has been laid to grade, with from four to six inches of graval, to prevent entrance

of silt and facilitate entrance of water. In very soft soil we have used a trough of one-inch lumber under the tile to preserve grade and prevent broken alignment of tiles.

The use of the tile drains instead of open ditches has several, advantages. Tile drains once placed do not have to be cleaned as do open ditches. In only two or three instances have drains become clogged in our three-year experience, and it is believed that the useful life of the average drain will be at least ten years, probably much more.

The use of tile drains permits plowing and cultivation by animal power which is not possible when frequent open ditches are encountered.

The covered drains permit all of the surface to be used for planting. In some cases 25 per cent more cane can be planted in the same field.

With covered drains the cutting and hauling of the cane is facilitated and none of the cane is lost by falling into open ditches

RESULTS

The object of a well-designed system of drainage is to lower the ground water level, thus permitting aeration of the soil and making available the plant food contained in that portion of the soil not previously reached by the feeding roots of the cane. This, in practice, makes available virgin soil to a depth in some cases of two or three feet. The effect is seen in the increased growth and production of the cane.

The first field drained by tile at Mercedita was planted to cane in September 1921, the wet part being plowed for the first time. Previous planting had been in holes made in the banks between ditches. The crop was harvested in 1923 with an average yield of 56 tons cane per acre. The previous record of this field was, 1917, 11 tons per acre; 1918, 27 tons per acre; 1919, 21 tons per acre; 1920, 28 tons per acre; and 1921, 27 tons per acre.

Another illustration of the possibilities of drainage was furnished by a field of low-lying land just east of Inabón River. This field was planted each year 1918–1919–1920 and nearly all the cane was killed by back water from the river each year.

In the summer of 1921 a dike was constructed to hold back the flood waters and a ditch made the inner side of the dike. Into this ditch drain tiles discharge the water from the filed, which is

only 4 to 5 feet above sea level. Owing to lack of fall for natural drainage the water is removed from the ditch by pumping it over the dike, about 4 feet lift. The result was a crop averaging 47 tons per acre on 20 acres of land that had given no crop from three previous plantings.

Similar instances can be multiplied from our own experiences and the work of installing tile drains in all fields that have required ditches is being pushed forward.

One of the inevitable consequences of irrigation is the formation of wet spots in many fields when the subsoil does not provide natural outlet for the surplus water applied. These wet spots after a few years become salty from the continued surface evaporation. Tile drainage offers a practicable means of remedying this condition and the earlier it is applied the better, since once the soil is thoroughly impregnated with salts it may take a number of years to remove the excess so that crops will grow again. Some of the earliest drains installed at Mercedita are still discharging saline water and part of the area drained will not produce cane, but these areas are growing smaller each year and we hope that within a few more years, the whole will be reclaimed.

An example of this condition is a field near Mercedita factory which has a salty spot near its center. This portion of the field was not planted for some years of failure to produce.

Tile drains were placed in the wet portion in the spring of 1921. The previous record of the field was:

1917 ------	4 *cuerdas*	Gran Cultura	40 tons per *cuerda*
1919 ------	7¼ *cuerdas*	Gran Cultura	37 tons per *cuerda*
1920 ------	7¼ *cuerdas*	Primavera	24 tons per *cuerda*
1921 ------	7¼ *cuerdas*	Ratoons	13 tons per *cuerda*

After tiling the whole field 10 *cuerdas* were planted as but only 9¼ acres were harvested, which gave a crop of 23 tons per acre in 1923 as *gran cultura* altho about one-half acre had practically no cane on it. The average for the 10 acres was 37 tons. The non-productive portion is smaller and it is expected that in another year or two cane will be growing on the entire area.

MORPHOLOGICAL SIMILARITY BETWEEN THE PHYTHIUM-LIKE FUNGUS FOUND ASSOCIATED WITH DISEASED SUGAR-CANE ROOTS IN HAWAII AND PORTO RICO

By B. A. BOURNE,
Professor Plant Pathology, College of Agriculture and Mechanic Arts

The first pathologist in more than two decades since 1896 to

FIG. 1.—Photomicrography of secondary rootlet of sugar cane near root tip showing area of dark reddish-brown tissue found in cases of typical *Pythium* root-rot. X 165.

claim that a fungus having characters resembling the genus *Pythium* was a primary cause of that condition in sugar cane known as "root disease" was Mr. C. W. Carpenter (1) of the Hawaii Agricultural Experiment Station. In fact, the experiments he described with this fungus in 1919 leave little doubt that it is a vigorous parasite under certain conditions in Hawaii and can be made to reproduce the typical symptoms of root disease under carefully controlled experimental conditions.

Prof. Earle (3) has already pointed out that Dr. Treub in 1885 and Dr. Wakker in 1893 have both found *Phythium* associated with root disease in Java, but that the more conspicuous *Marasmius* seems to have attracted Dr. Wakker's attention as well as that of subsequent investigators and no further mention of the former fungus as being associated with a cane disease has been found in literature until that of Carpenter previously mentioned.

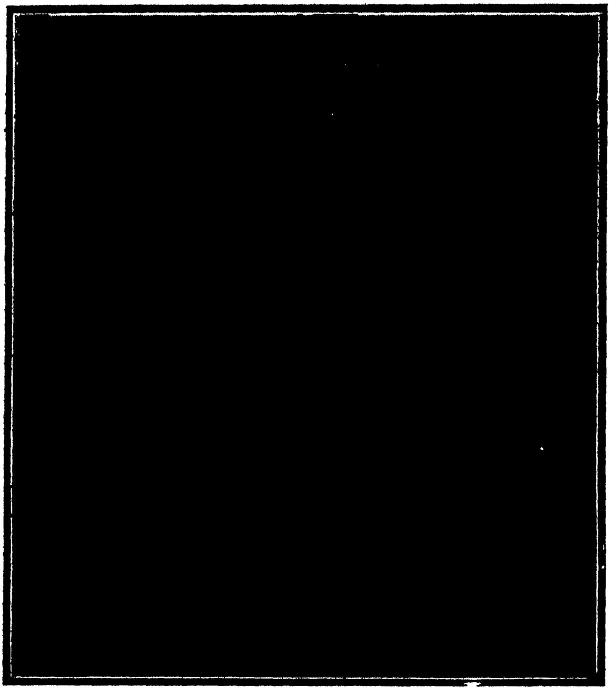


FIG. 2.—Photomicrograph of a longitudinal section through a reddish-brown diseased portion of a primary cane root affected with *Pythium* root-rot. Note the thick type of mycelium seen in one of the epidermal cells in the center of the picture. X 170.

Here in Porto Rico the first mention of *Pythium* as being isolated from roots of sugar cane suffering from root disease was recorded in 1920 by Mr. Matz (4) recently Pathologist of the Insular Experiment Station. Although Mr. Matz's experiments leave little doubt that *Pythium* is a vigorous parasite on cane roots under certain conditions and can be made to induce rot in these under experi-

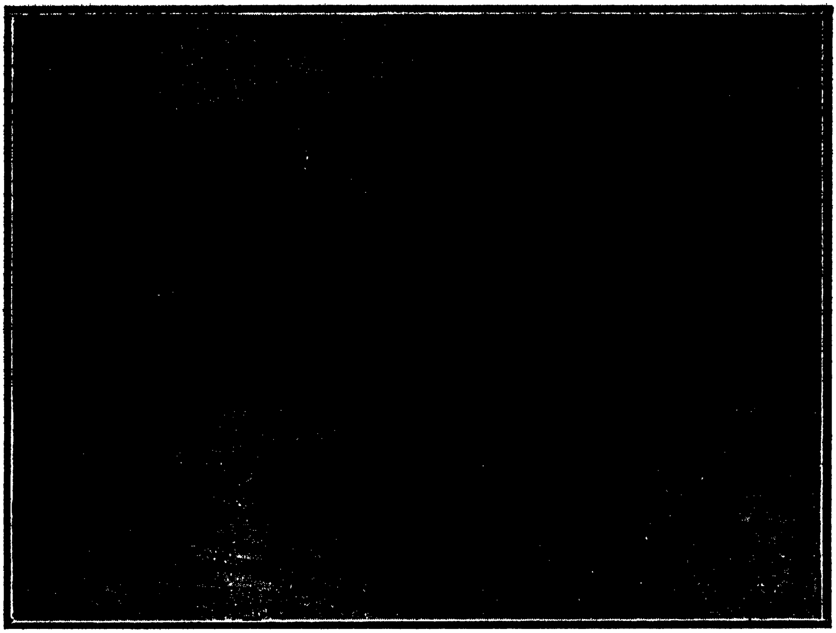
mental conditions just the same as was shown by Carpenter in Hawaii, yet it has not been satisfactorily demonstrated that the species present in Porto Rico can reproduce all the true symptoms of root disease, including marked stunting of the cane such as is claimed by Carpenter for the Hawaiian fungus. So far as is known, inoculation experiments with *Pythium* sp. under Porto Rican conditions have not yet been tried with the *Lahaina* variety (probably the same as the Bourbon, Otaheite and Caña Blanca) which is known to be particularly susceptible and which was used by Carpenter in his inoculation experiments.

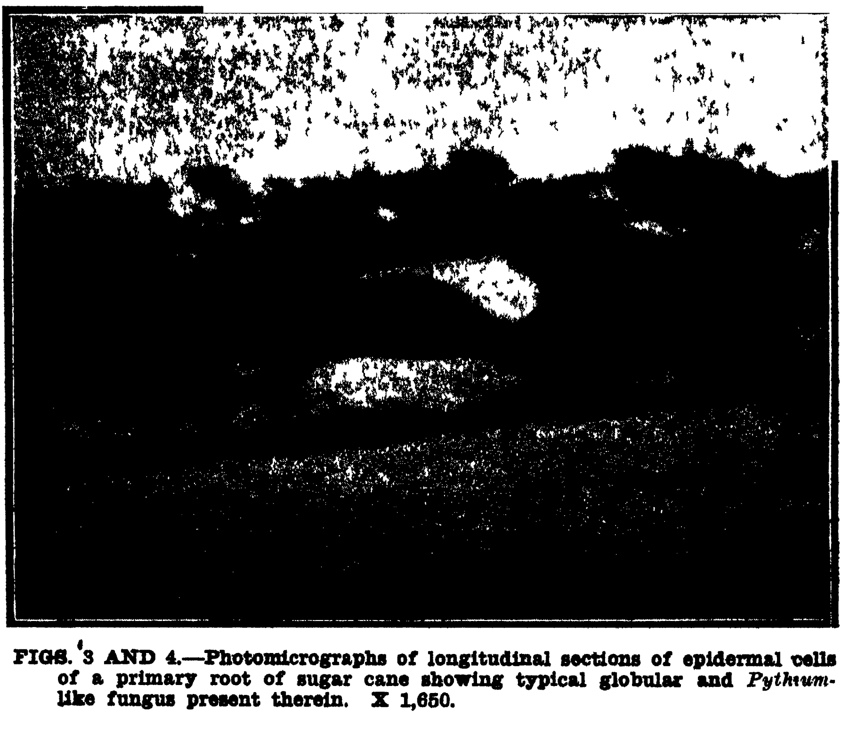
In the absence of definite evidence, therefore, as to whether we have here a different species of *Pythium* or a different biological strain of the same species as is found in Hawaii, it would seem desirable to present evidence relative to the morphological similarity between the two fungi as they exist naturally in cane roots and also in pure culture in the two countries. It is not the purpose of this paper to discuss the life history of the species of *Pythium* found here, since this would not clear the situation in the absence of similar studies with the Hawaiian parasite. So far no detailed description or figures of the *Pythium* found in Porto Rico have been published, and the writer believes that in presenting certain results recently obtained by a histological examination of roots of cane affected with this fungus, together with certain observations of pure cultures of the parasite, he will be throwing some light on the similarity between the organism found here and the one described from Hawaii.†

Figure 1 represents a typical secondary rootlet of cane[1] affected with *Pythium* root-rot. The dark reddish-brown area toward the central portion of the stele seems to be quite characteristic and is usually present a short distance back from the root tip, being often easily visible to the naked eye. This typical appearance is found also in tertiary roots. The exact reason why the fungus

† Since this paper was prepared, the writer has seen a copy of Mr. Carpenter's subsequent paper entitled "*Morphological Studies of the Pynthium like Fungi Associated with Root rot in Hawaii*". Bul. Exp. Sta Haw. Sug. Pl. Assoc. Bot. Ser. 3: 59–65. 1921, and also Dr. H. M. Fitzpatrick's paper on "*Generic Concepts in the Pythiaceae and Blastocladiaceae*". Mycologia: *15* · *166–173*. 1923. Not only is it abundantly clear that the Porto Rican fungus is morphologically identical with the Hawaiian type, but according to Dr. Fitzpatrick it is really a *Nematosporangium*, the thicker type of globular, mycelium-like structure found in the epidermal cells (see figs. 3 and 4 present paper) being the true sporangium or asexual stage The latter author has suggested the name *Nematosporangium aphanidermatum* (Edson) comb. nov. for this fungus.

[1] B. 6450 variety was the one studied throughout for the purpose of writing this paper.





FIGS. 3 AND 4.—Photomicrographs of longitudinal sections of epidermal cells of a primary root of sugar cane showing typical globular and *Pythium*-like fungus present therein. X 1,650.

reacts so peculiarly with the host tissue in the region of the young root, where the distinct tissues of cortex and stele are beginning to become differentiated is as yet not clearly understood. Similar reddish-brown lesions are also to be found on tender primary roots, although these are scattered irregularly and may be quite large (over a centimeter in length) owing to the gradual extension of the fungus from the original point of entrance, and perhaps also to the coalescence of individual lesions.

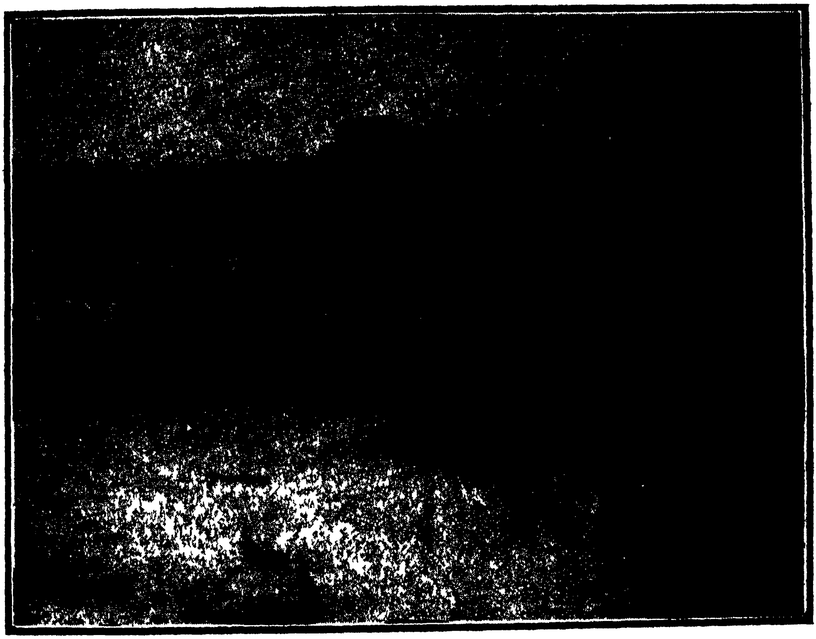


FIG. 5.—Photomicrograph of longitudinal section of epidermal cell of a primary root of sugar cane showing typical fine, cylindrical type of *Pythium*-like mycelium ramifying throughout the interior. X 1,650.

Figure 2 is a longitudinal section of a primary cane root showing one of the epidermal cells invaded with the thicker type of *Pythium*-like mycelium. It is interesting to note that this type of mycelium is seldom found any deeper than the first two layers of cells in the root and most commonly just in the epidermal layer as shown in figures 2, 3, and 4. Figures 3 and 4 show the typical globular and characteristically shaped mycelium of the *Pythium*-like fungus inhabiting the epidermal cells of an affected primary root. The writer

especially desires to draw attention to the great similarity between this mycelium and that figured by Carpenter in Hawaii. It is worth mentioning, moreover, that this thicker mycelium stains quite easily with safranin (1 per cent solution in 50 per cent ethyl alcohol) whereas the finer type seen ramifying in the epidermal cell shown in Figure 5 is so poorly stained with safranin that it could not be recognized except with the greatest difficulty. The iron-alum-

FIG. 6.—Photomicrograph of a living pure culture on corn meal of the *Pythium*-like fungus associated with cane root-rot. Note typical branching of mycelium and abundant production of oögonia. X 165.

haematoxylin cytological stain was found to be far superior for staining both types of the *Pythium*-like thallus. Carpenter also mentions and figures a similar type of fine cylindrical mycelium as shown in Figure 5 inhabiting an epidermal cell. This type of mycelium in addition to being found in epidermal cells has also been seen by the writer inhabiting root hairs, and in fact numerous stained sections show it to be present throughout the cortex and stele tissues as well as at the origin or secondary roots. As a whole this

type of thallus seems to predominate in the roots, but will easily escape recognition unless suitably stained as metioned above.

Carpenter (1) mentions that the *Pythium*-like fungus he obtained in Hawaii produced oöspores on rice cultures, while Earle (3) in Porto Rico states that oöspores were produced abundantly in Mr. Matz's cultures. Fig 6 shows how abundantly oögonia are found in young pure culture of the Pythium-like fungus on corn meal isolated by the writer. Fig. 7 shows some of these oögonia more highly

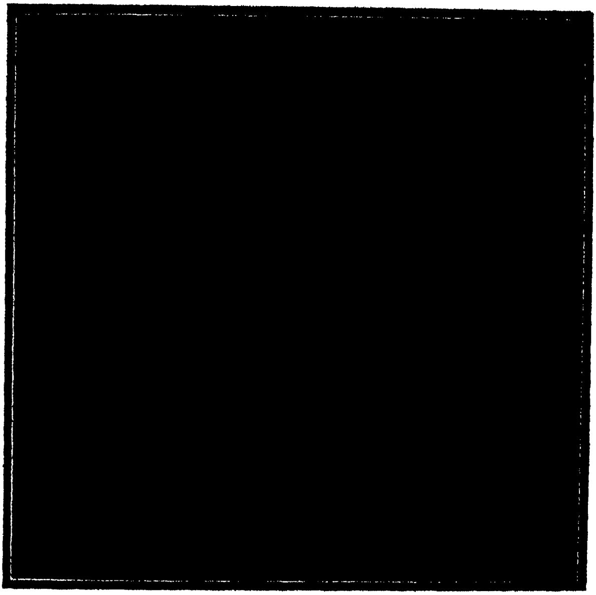


FIG. 7.—Photomicrograph of living culture of the *Pythium*-like fungus on corn meal. *x*, antheridium attached to wall of oögonium; *y*, oösphere or egg cell. X 943.

magnified and in addition one of them may be seen to have a typical antheridium (X) firmly attached to its outer wall for the purpose of fertilizing the oösphere, or female egg cell (*y*) present within. Great similarity is here noted in the manner of fertilization of the oösphere as figured by Carpenter.

Fig. 8 shows the oöspores formed after fertilization. At this stage they have not yet been freed from the wall of the oögonium (*a*) and in addition to being invested with a thick inner wall (*c*), they also are surrounded by a relatively thicker layer of prei-

plasm (*b*) which is seen in the preparation to have taken the stain with difficulty. Anton De Bary (2) regards this periplasm layer in the case of the genus *Pythium* as an inconspicuous, sparingly granular mass of protoplasm surrounding the oöspore, but which cannot be seen to take part in the process of its maturation. It is possible that it may serve as a protective covering when the oöspore is liberated, or it may soon be dissolved away.

FIG. 8.—Photomicrograph of stained preparation of *Pythium*-like culture showing two mature oospores. *a*, wall of ooganium; *d*, periplasm layer; *c*, inner wall of oospore; *d*, probably the nucleus of the oospore. X 1,073.

As far as comparison of the fungi from the two countries is concerned, relative to the size of mature oöpores as well as oögonia at the time of fertilization, this is hardly possible at present since the average sizes of these structures calculated from a large number have not apparently been worked out for the Hawaiian organism. Furthermore, the writer has not grown his organism on rice cultures as used by Carpenter, but on sterile corn meal as well as dextrose potato agar, so that it is feared that this difference in medium would

be a serious objection if accurate comparison in the size of these organs was undertaken. However, the similarity in size is indicated by making use of the figures of definite magnification given for the Hawaiian organism.

A typical oöspore figured by Carpenter on Plate 8, Fig. F. shows the inner granular oöspore, without the periplasm and oögonium wall, to be 15 microns in diameter. Both oöspores figured by the writer in Fig. 8 have a diameter of 12.12 microns without the periplasm and oögonium wall. Thus there is only a difference of about three microns, a variation easily possible in the same strain on different media.

SUMMARY

1. Histological investigation of roots of B. 6450 variety of cane in Porto Rico suffering from *Pithium* root-rot has demonstrated thas this fungus as it exists in the tissues, bears a remarkable norphological similarity to the *Pythium*-like organism figured by Carpenter from Hawaii in the roots of the Lahaina variety.

2. Iron-alum-haematorylin cytological stain has been found very suitable for staining both the thick and globular as well as the fine cylindrical types of *Pythium*-like thallus in cane roots. The latter type of mycelium was found to be by far the most common in the root tissues examined, the former kind being confined mainly to the outer one or two layers of cells.

3. Pure cultures of the *Pythium*-like fungus on sterile corn meal produce abundant oögonia having oöspheres which are apparently fertilized in a similar manner to the Hawaiian organism.

4. Such comparison as has been possible shows that mature oöspores of the organism from the two countries are so similar in size as to possibly come within the range of ordinary variation within the species.

Department of Plant Pathology, College of Agriculture and Mechanic Arts, Mayagüez, P. R.

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By

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SOME JAVA P. O. J. SEEDLINGS IN TUCUMÁN AND PORTO RICO *

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Despite the marvelous advances in scientific agriculture in the past quarter century the extension and usefulness of imported varieties of both plants and animals are still frequently as much influenced by popular fancy or caprice as by the actual economic or environmental factors. In the case of varieties of sugar cane, size and appearance, yes, even a characteristic color or mode of growth may exert more influence than their actual productivity or resistance to disease and it appears to the author that we could find no better illustration of this fact than the case of *D-433*, the well-known *Cenıza* cane, which has proven so valuable under the peculiar conditions of Central Fajardo, in Porto Rico. Careful experimentation and years of experience at this progressive central have demonstrated beyond the shadow of a doubt the value of this cane—normally a variety of good tonnage but indifferent sugar content—under the conditions of most of their properties, but this demonstration under limited conditions does not justify the wide distribution of the *D-433* under materially distinct environment of soil and climate. No one will deny, we think, that the good size and ease of identification of this variety, as well as the notoriety it has received from its good record at Fajardo, have been more potent factors in its wide distribution on the Island than results of carefully conducted field trials under the actual conditions of the many other sections into which it has of late years been extended.

With this case in mind, it has occurred to the writer, who has had some fifteen years of experience with a number of the *P. O. J.* seedlings from Java, which have for the time being at least, settled the disease problems of the Argentine sugar district, from where several of them were sent to Porto Rico, that some similar factors

* Paper read at the meeting of the "Association of Sugar Technologists of Porto Rico" held June 14, 1924, at San Juan, P. R.

might have influenced the rather wide distribution of the so-called *Egyptian* cane, *P. O. J. 105* in the sections of the Island most heavily punished by Mosaic Disease, in comparison with others of its sister varieties which in Argentine gave us far better results than the rather striking-looking *P. O. J. 105*, and, at the suggestion of Commissioner of Agriculture Mr. Carlos E. Chardón, an investigation of the comparative behavior of these *P. O. J.* canes in the two countries was begun early this year. The writer has gone rather greatly into detail in considering the Tucumán experiments but feels that a full description of methods and detailed discussion of results in these early experiments are pertinent to the matter in hand, and, given the epoch-making results from these experiments, which, by bringing about a complete change in the basal variety of a whole district, are perhaps unique in Experiment Station history, worthy of rather extended attention.

Climatic Conditions of Tucumán

The province of Tucumán—the smallest and most thickly settled of the Argentine States—lies between the 25th and 26th parallels of south latitude, the cane-growing sections being located at elevations of between three hundred and five hundred metres above sea level. The climate is distinctly subtropical, with all of the changes and surprises that that word implies. The summers are extremely warm, temperatures of above 48 degrees Centigrade in the shade having been recorded, and usually extremely rainy, although there are occasional droughts during the summer season (186)[1]. The usual rainfall is just about one meter annually, which in normal times falls mostly during December, January and February, more than 50 per cent of the annual precipitation occurring in these three months. This is an ideal distribution of a deficient rainfall for cane growing, coming as it does at the time of greatest heat and hence being taken advantage of during exactly the principal time of the development of the cane. The winters are generally cool and rainless—in most years rivalling the famous Mediterranean coast resorts in their brightness and balminess—with a continuous succession of fresh, sunshiny days and nights just cool enough to stimulate rapid ripening of the cane. At times heavy frosts fall, which, depending upon the time of their arrival, do considerable harm to the sugar content and purity of the juices of the cane and also affect

[1] Numbers in parenthesis refer to references in annotated bibliography (Appendix C).

the stand for the following year. This is particularly so if the frosts happen to come in late fall or very early winter and follow upon warm, growing weather.

HISTORY OF THE FIRST TUCUMÁN EXPERIMENTS

The Tucumán Sugar Experiment Station was established in 1907 by a more than usually progressive government in order to study the causes of the constantly falling-off yields of cane in the province (182). At the time the law was passed it had been evident for several years that the cane was suffering either from some distinct disease or from a general degeneration such as had already occurred in several countries where the same type of cane (*Rayada*) as formed the basis of the Tucumán cane fields had before been generally cultivated. This trouble later proved to be the same now famous Mosaic Disease which was destined within a few years to cause so much consternation and loss here in Porto Rico—and at the same time to give such a decided stimulus to varietal investigations on the Island.

The work of the new Experiment Station, due to the necessity of finding personnel for work under the peculiar conditions of Tucumán—conditions most closely approximated by those of Louisiana—and of obtaining proper apparatus and securing sufficient preliminary data with which to begin serious investigational work, was begun only in 1910. By this time the Mosaic infection was practically 100 per cent all over the Province and it was clearly seen that the most hopeful line of investigation was along that of varietal resistance or immunity, as control measures of any other sort, given the extremely heavy infection, were practically impossible.

In 1910 one hundred and twenty-six varieties of cane were imported for trial under Tucumán conditions directly from the Louisiana Experiment Station at Audubon Park in New Orleans, these canes representing varieties from almost all the well-known cane countries which were then being experimented with in Louisiana, amongst them being various of the better-known Barbados, Demerara and Louisiana seedlings, *Bourbon*, *Caledonia Queen*, *Cavengire*, *Co'lyns' Seedling*, *Lahaina*, *Rose Bamboo*, *Salangore*, *Tamarín* and *Zwinga* (17). In the same year seventy-six additional varieties were obtained from the Campinas Experiment Station in Brazil and each succeeding year promising canes were imported from other countries, amongst these latter being the Hawaiian

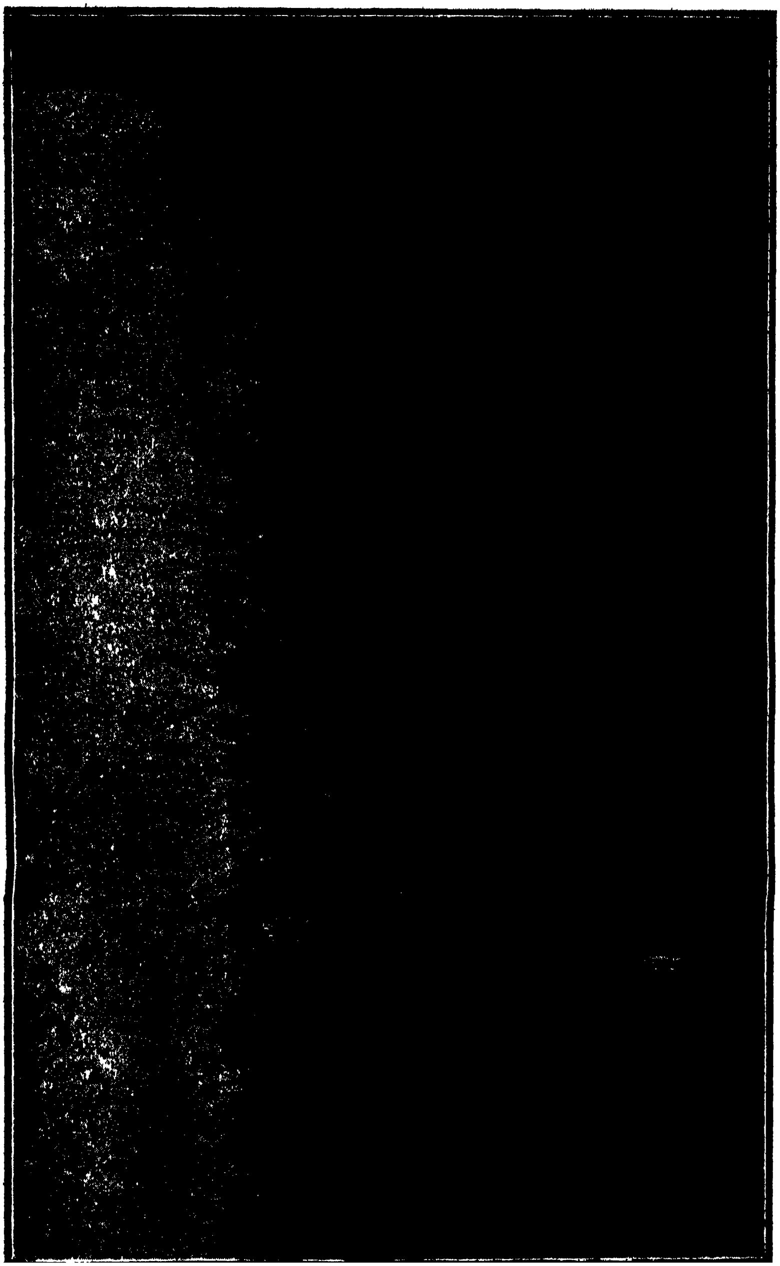

FIG. 1.—One of the two varieties of cane which saved the Argentine Sugar industry. P. O. J. 36 in the Tucuman Agricultural Experiment Station

seedlings Nos. *27*, *146*, *227* and *240* (76). Hence it will be seen that the Java varieties which we are now going to discuss had to compete with canes of well-established merit and not only with the basic canes of the Province.

Six of the *P. O. J.* series of Java seedlings were imported into Tucumán direct from Java in the year 1908, as a result of the law creating the Experiment Station, by then Governor Luis F. Nougués, one of the most progressive and far-seeing officials that Tucumán has ever had, and it is a noteworthy fact that three of these canes—the *P. O. J. 36*, *213* and *234*—so far surpassed all other varieties in agricultural and factory yields under every condition of the Province that within a few years they entirely replaced the commonly planted *Rayada* and *Morada*, and practically all other varieties which had been tried up to that time (194).

While in cultural experiments or in the control of insects or plant diseases the cooperation of the cane growers and, hence, the rapid obtainment of large-scale results is not very easily secured, there is probably no branch of the very diversified work of an Experiment Station in which the public in general takes so keen an interest as that treating of the introduction or breeding of new varieties of plants. Such huge benefits may be obtained in any district through the finding or creation of a new variety of plant which gives notably better results than the varieties actually cultivated in that section and the expense of obtaining this benefit is usually so much less than that incurred in judicious fertilization or for control measures against insects or plant diseases, etc., that the agriculturist follows with much interest any efforts made towards the end of securing him a better variety which will give him larger returns than those he is actually cultivating. This is probably particularly the case in sugar districts, more especially in one like Tucumán, where it was evident when these experiments were started that the variety under cultivation generally at the time was gradually having its yields reduced to absolutely bankrupt figures (184). This fact must be borne in mind in considering the very rapid change of varieties which has come about as the result of the experiments with these new canes.

What points of superiority, then, had we to seek in judging the new canes in comparison with the old standard ones? Leaving aside the question of frost resistance, which is of no interest to us here in Porto Rico, they were four, as follows:

1st. Greater tonnage, with
2nd. Juices containing a higher percentage of crystallizable sugar.
3rd. Greater resistance or immunity to the attacks of Mosaic Disease and other cryptogamic diseases and insects.
4th. The furnishing of more and better fuel as *bagasse*.

Too much time would be occupied were an attempt here made to discuss the various complicated features of our extremely careful system of control of our variety experiments. Suffice it to say that the only variant introduced into these experiments was that of the VARIETY and that differences in agricultural or industrial yield at the time of crop may safely be attributed to differences in characteristics of the varieties themselves. Besides having the varieties on plats as nearly apparently equal throughout their extensions as possible and seeing that every detail of preparation, cultivation, fertilization and harvesting was absolutely identical for all varieties, every individual cane was not only weighed out *counted* it at crop time and the method of obtaining a truly representative sample of each variety for analysis, while too detailed for explanation here, absolutely guaranteed a very true sample.

The experiments were started in 1910, the land selected for the varietal plat under discussion being well plowed with a 26-inch disc plow and harrowed with an ordinary tooth harrow. Rows were indicated with a wooden plow at two metres, then cleaned and deepened with a large double mouldboard plow, the cane being planted in continuous double row the latter part of July, 1910. Three irrigations were given, one each in July, August and September. Fertilizer was applied at the rate of 535 pounds per acre of a mixture consisting of 50 per cent dried blood, 40 per cent superphosphate and 10 per cent of potash. In September the middles were cultivated with a large four-shovel cultivator with the shovels reversed so as to throw the dirt to the middles and the rows were then weeded with spades. In November the middles were cultivated with a light tooth cultivator drawn by one mule and in December a second weeding was given to the rows. Early in January the small cultivator was again sent through the middles, followed, on account of the extremely weedy condition due to recent rains, by a small mouldboard plow. The middle of January the cane was again weeded and early the following month the large cultivator was again sent through, this time with the shovels set to throw dirt to the

rows, the cane being then laid by with spades. Early in March the last cultivation was given with the large middle cultivator, three additional irrigations being then given up to the middle of April 1911. The harvest was made the middle of July, with the results shown in Table I.

Now, as to the first-year stubble—in the middle of September, 1911, the middles were burst out with an ordinary mouldboard plow and the cane off-barred with the same implement with a knife coulter attached. Only one irrigation could be given the first-year ratoons on account of shortage of water, this being at the end of September. Fertilizer was applied as with the plant cane, a little dirt being thrown to the cane when the fertilizer was lightly covered with a small share plow. Early in December the cane was cultivated with the large four-shovel middle cultivator and the six-disc straddling sugar cultivator. About the end of January, 1912, the small tooth cultivator was sent through each middle twice, this completing the cultivation. From this it will be seen that extremely little money was spent on cultivating the stubble cane, no spade or plow work being done after returning the first dirt. The harvest was made early in June, with the results shown in Table I.

As second-, third- and fourth-year stubble, about the same methods were employed as described for the first year stubble. In September each year the middles were broken out and rows off-barred as already described, this work being followed with one or two irrigations in October, which is usually a very dry month. The second-year stubble was fertilized the first part of November with the same mixture mentioned above, the fertilizer being dropped by hand along each side of the row and lightly covered with a small mouldboard plow. No fertilizer was given the third- and fourth-year stubble or thereafter through ratoons. The latter part of November the large four-shovel cultivator was sent down each middle of the second- and third-year ratoons, while for the fourth-year stubble a Planet Jr. eight-tooth cultivator was employed with good results. In December the rows were given one weeding with spades as second- and fourth-year stubble, but as third-year stubble the Java canes had such a remarkable stand that they were not weeded, only the *Rayada* being thus weeded. This was in 1913 when no frost fell in Tucumán and, therefore, all cane could make its best development. For the lay-by the large straddling six-disc sugar cultivator

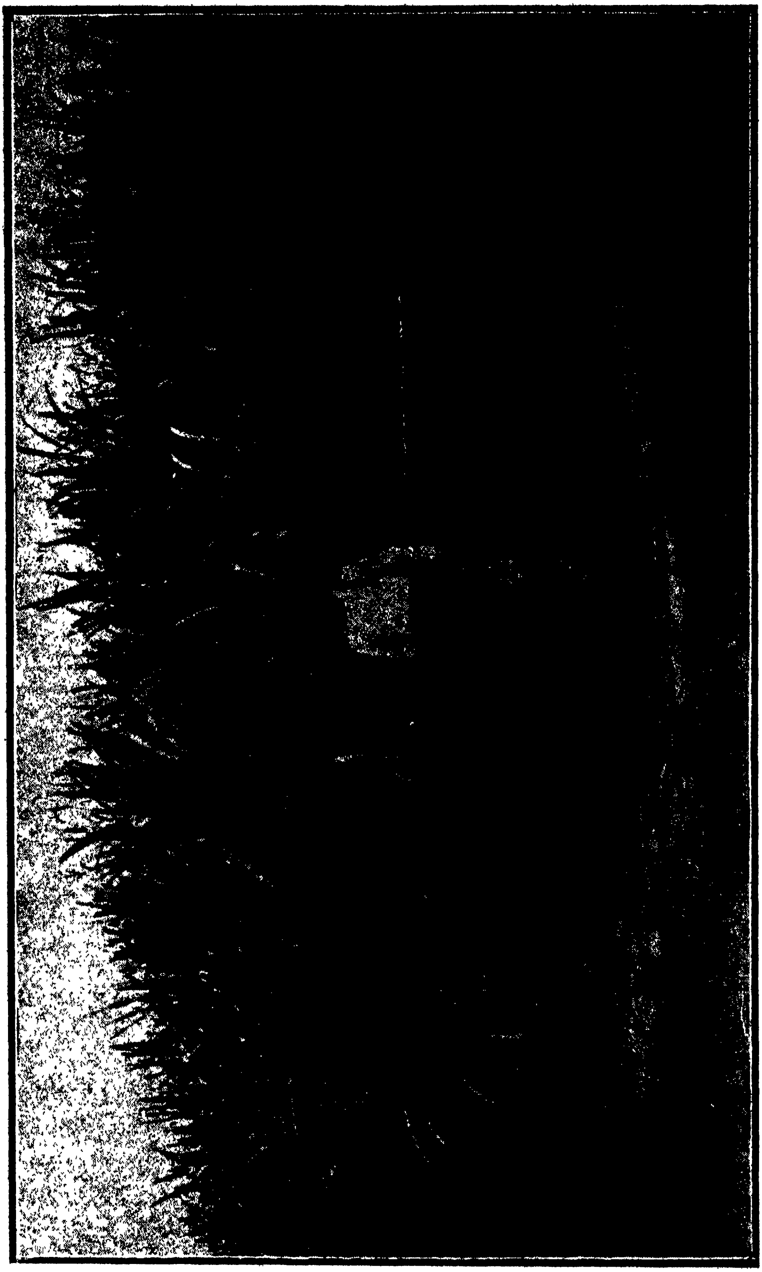

FIG. 2.—The so-called ''Egyptian'' cane, P. O. J. 105, in Tucumán Station

was always employed, the time at which it could be done depending on how early a start the stubble got after crop, the amount of spring rainfall, etc. As second stubble the cane was laid by very early in January, 1913, whereas the third-year stubble got its final lay-by the first part of December of the same year. As fourth-year stubble in 1915 the lay-by was completed the last of December. Usually in January a small tooth cultivator drawn by one mule was sent down the middles, and the second stubble was given an irrigation in January 1913. As third and fourth ratoons the *Rayada* cane, on account of its poorer stooling, was given a weeding in March, but no later weedings were given to the Java canes. Crop in each case was made either in July or August, all results being shown in Table I, which we will now study in detail.

TABLE I

Results from Five Successive Crops from First Planting of Java P. O. J. Canes, Tucumán Agricultural Experiment Station

Analyses and Rendement of Plant Cane (1911) and Four Successive Stubble Crops (1912–1915)

Variety	Metric tons cane per hect.	Average weight stalks Gms.	Chemical analyses of juices					Kgs. of sugar recoverable per hect **
			Brix	Sucrose	Glucose	Purity	Manufg. value *	
P. O. J. 36	84.20	520	17 9	14.5	0.2	81.1	11.76	2815
	76 14	1100	17 0	13 6	0.8	80.0	10 88	5799
	83 40	1101	19.8	16 8	0 2	84 5	18.80	8056
	78.65	730	20.0	17 1	0.2	85.5	14 60	7527
	65.60	680	14.8	11 8	0.9	82 5	9.70	4454
Average.....	66.60	810	17.7	14 7	0 8	83.1	12.20	5687
P. O. J. 213	30.55	840	17.4	14 7	0 1	81.5	12 42	2656
	91.59	790	16 5	13.7	0.1	83 1	11.88	7296
	108.80	690	19.9	17.2	0.8	86.5	14 90	11348
	54.60	580	17.9	14 8	0.8	82.7	12.80	466
	80.80	470	16.6	14.2	0.2	85.5	12.10	6844
Average.....	73.27	580	17.7	14.9	0.2	84.2	12.50	6411
P. O. J. 231	28.85	450	19.5	16.8	0.1	86.2	14.48	2924
	59.50	790	18 1	15.5	0.1	85 7	13.28	5581
	65.20	720	19.7	17.2	0 1	87 3	15.00	6845
	46.65	720	21.6	19.2	0.1	88.9	17 10	5464
	51.85	580	15.5	12.4	0.4	80 0	9 90	3593
Average.....	50.21	640	18.9	16.2	0.2	85 7	13.90	4885
Rayada	21.75	480	16 1	13.2	0.4	[illegible]	10.82	1647
	27 84	780	16.0	13 8	0.5	86 3	11.91	2279
	34.46	820	17.2	15.2	0 3	88.4	13.40	3282
	17.40	650	20.4	18.4	0 1	90.2	16 60	2022
	14.80	550	15.2	12.2	0.4	80.8	9.80	1015
Average.....	23.15	650	17.0	14.8	0.3	87.1	12.90	2090
P. O. J average...	63.36	677	18.1	15 8	0.2	84.3	12.90	5661

* Obtained by multiplying per cent sucrose by purity—usual factor in Tucumán.
** Calculated from a basis of 70 per cent extraction of juice on cane.

Taking up first the results from the plant cane, we find that the largest production of sugar per hectare was made by the *P. O. J. 234*, all the analyses, however, being very good for cane cut so early, July in Argentine, of course, corresponding to January here in Porto Rico. All three of the Java varieties gave sugar contents superior to that of the *Rayada.* In tonnage of cane produced the *P. O. J. 36* headed the list, having also the best average weight of stalk. The Java canes produced an average of over one ton more sugar per hectare than did the *Rayada* check plat.

The first thing that strikes us about the results of the first ratoons is the tremendous increase of the yields of the Java varieties over their production of the previous year, both in tonnage and in average weight of stalk. It was this particular comparative increase that made us consider these Java canes so promising and caused us to immediately start large sub-station experiments in all parts of the Province, because in the second year they already appeared to be adapting themselves well to their new environment and conditions of growth, especially when we consider that in their native home cane is grown only as plant. Incidentally, the large sub-stations started in 1912 corroborated the results obtained at the central Station in every respect and were an important factor in diffusing knowledge in regard to these canes and in multiplying the supply of seed then existent (10).

As first stubble the *P. O. J. 213* stands head and shoulders above all the rest, with over ninety tons of cane per hectare and $7\frac{1}{4}$ tons of sugar and this in comparison with very good yields from the *Rayada*, as Tucumán averages for their native canes went, of over 27 tons of cane and $2\frac{1}{4}$ tons of sugar per hectare, against a normal average for the Province of about twenty tons of cane and $1\frac{4}{5}$ ton of sugar. All of the Java canes more than doubled their yields as plant, the *P. O. J. 213* more than trebling that on previous year, while the *Rayada* increased its yield of cane but $5\frac{1}{2}$ tons and its sugar about three-fifths of a ton per hectare.

As regards the chemical analyses of the juices, the *P. O. J. 234* again leads all the rest, as it did as plant cane. The average production of cane and sugar per hectare of the Java varieties is some 150 per cent higher than the very respectable *Rayada* yield, the *average weight of stalk also, contrary to public opinion, due to the* thinness of these canes being slightly superior—that of the *P. O. J. 36* very much higher.

As regards the results of the last three years of stubble, attention should be called to the fact that the years 1913 and 1914 were the two most favorable years ever known for cane growing in the Province of Tucumán, there being abundant railfall in these years and practically no frost anywhere in the Province. 1915, on the other hand, was a disastrously dry and cold year, breaking all previous records for low yields until 1916 and 1917 each in their turn established new high-frost and low-yield marks.

Table I hardly needs extended discussion, as it very volubly speaks for itself. We need call attention only to the enormous differences in the average yields for five years of the Java and native cane, the latter showing an increase of from 140 to 220 per cent in yield of sugar per hectare under identical conditions of growth and under less expense for cultivation than the *Rayada*. It is also worth noting that the *P. O. J. 234*, while the lowest in tonnage of the Java canes, has given the highest average sucrose content and proven itself a very early maturing variety.

The Second Series of Tucumán Experiments

After obtaining three years' splendid results with these new canes, in sub-stations distributed all over the Province as well as those detailed above in the main Station, we decided to start a special lot of larger scale experiments with these more promising varieties. A piece of land, which had carried alfalfa for two years and was, therefore, in the best of condition for receiving cane, was selected for the experiment. The land was well prepared in July, 1913, and planted in rows 1.66 meters apart instead of at two meters as in the first experiment, the cane being covered with a small mouldboard plow as before. The system of cultivation was practically the same as outlined for the first series of experiments, this latter one being run for three years (one plant crop and two ratoons) or until the check plats, as in the case of the other experiment, had been reduced to such irrisory figures that comparison would no longer have been possible. Incidentally it might be mentioned that the *P. O. J.* canes in this first series of varieties were left to grow and furnish data on their duration as ratoons, of which anon, for as many years as possible after these comparative figures were discontinued on account of the lack of a check and the *P. O. J. 36* and *213* have continued to give splendid yields

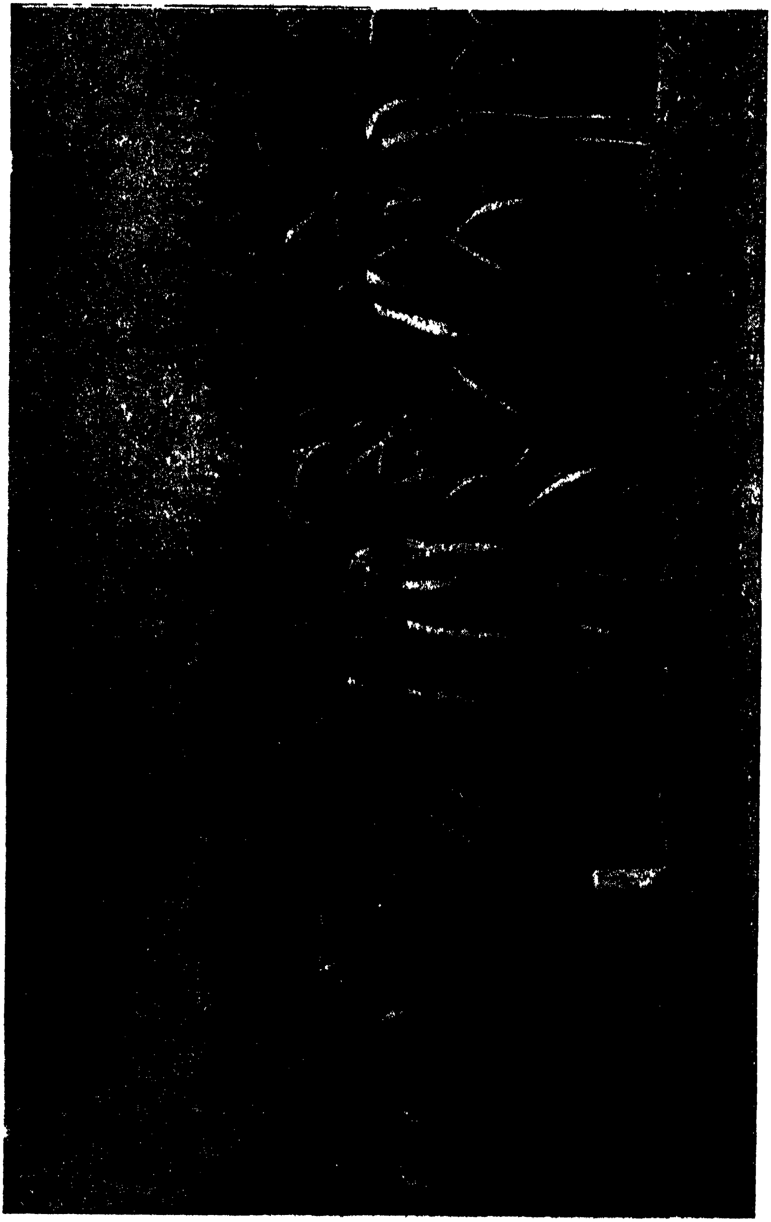

FIG. 3.—Another Argentine benefactor. P. O. J. 213 at Experiment Station

through the twelfth year stubble. The thirteenth stubble crop has grown splendidly and will be harvested shortly.

As will be seen from Table III, when the second series of experiments was discontinued the *P. O. J.* canes were still giving very substantial stubble yields and these have continued to date also. No comparative results can be calculated, however, where the check plats have become so depreciated in their yields.

In this second series of experiments an interesting study was made of the germinative potency of the different canes, one of the factors which well explains the success obtained from the Java canes in the Argentine. Beginning about the middle of September, 1913, a count was made each week of the number of sprouts above ground in one row of 100 meters in length of each variety until suckering began in abundance. Table II gives the results of these investigations.

TABLE II

Comparative Germination of the Varieties

Variety	Number of sprouts above ground per row of 100 metres									
	September		October					Nov 6	Crop Sept 1-14	%canes under 10 mos
	18	25	2	9	16	28	30			
P. O. J. 36.....	81	191	325	391	499	574	607	682	1406	51
213 ...	62	140	218	288	288	347	361	486	1323	68
234 .	196	331	434	496*	548	618	701	856	1315	35
Rayada ...	66	150	186	210	224	270	304	312	564	45
P. O. J. average	96	222	326	375	443	513	556	675	1348	50

Nothing could illustrate better than this table the strong germinative tendencies of the Java canes as compared with the native. Both in experimental tests and in field observations we have always noted that the *P. O. J. 234*, in common with most high-sugar content and early maturing canes—*B 208*, for instance—is a very quick germinator, whereas the *P. O. J. 213*, particularly in dry seasons, germinates very tardily and seems to make its best growth from the time of coming of the real summer months. Both of these tendencies are very well shown by the table. On September 18th the *P. O. J. 234* had three times as many sprouts per row as its closest rival—the *Rayada*—and on the 9th of October still had twice as many sprouts as the *P. O. J. 213*, but, nevertheless, at crop time the *P. O. J. 213*, which had suckered vigorously after November, had matured more stalks per row than the *P. O. J. 234*—stalks, by the way, with greater average weight by 190 grams. Another interesting comparison is that between the *P. O. J. 213* and *36*, the

latter variety which we have always found to be a quicker germinator than the former. On the 18th of September the *P. O. J. 36* had just exactly half the number of sprouts per row as the *P. O. J. 213;* nevertheless, just one week later the *P. O. J. 36* had 51 sprouts more than the *P. O. J. 213* and at the time of the last count on the 6th of November, the *P. O. J. 36* had almost 200 sprouts per 100 meter row more than the *P. O. J. 213.*

Another interesting point which this table brings out is that when we talk of twelve- or fourteen- or sixteen-month cane, we are not describing by any means exactly the average age of the canes we are sending to the mills. Of the *P. O. J. 213* cut at the harvest of these plant canes on the 1st of September, 63 per cent had started growth after the first week in November and, hence, had a maximum growth of but ten months. Over half of the stalks of the *P. O. J. 36* germinated after the first week of November, about one-third of the *P. O. J. 231* and almost half of the *Rayada.* An interesting field of research along this line remains open in studies of our varieties—some attempt to define exactly what the terms "fifteen-month" or "eighteen-month" cane mean, give some idea of how old the average cane really is at these different ages with the distinct varieties.

An examination of the results of three crops from this plantation, *i. e.*, the plant cane of 1914 and the first and second ratoons of 1915 and 1916, respectively, the latter two disastrously unfavorable crops for all Tucumán cane, shows us (Table III) that in this series of experiments the comparative results of the Java varieties and the native cane are even more striking than in the former series. So evident it this superiority that comment on the table is is unnecessary, hence we can turn our attention for a moment to Table IV, giving the average results for the eight crops from the plantings.

TABLE III

Results from Three Successive Crops from Second Planting of Java P. O. J. Canes, Tucumán (Argentina) Agricultural Experiment Station

[Top lines represent plant cane (1914), middle lines first stubble and bottom lines second-stubble (1916)]

Variety	Metric tons cane per hect.	Average weight per stalk Gms.	Chemical analyses of juices					Kgs. of sugar recoverable per hect.
			Brix	Sucrose	Glucose	Purity	Manufg value	
P. O. J. 36	87.72 101.58 86.15	1040 900 700	17.8 16.1 17.1	14.0 12.4 13.6	0.6 0.8 1.2	80.0 77.0 79.5	11.80 9.50 10.80	6989 6755 6512
Average....	91.82	880	16.8	13.3	0.9	78.8	10.53	6785
P. O. J. 213	59.46 10.36 64.88	750 490 480	18.5 14.5 14.7	13.0 11.4 11.9	2.1 0.6 0.7	70.5 78.6 81.0	9.20 9.00 9.60	3829 3803 4360
Average....	61.57	573	15.9	12.1	1.1	76.7	9.27	3997
P. O. J. 234	43.80 44.16 41.27	560 540 480	17.0 15.4 15.8	13.6 12.0 12.8	0.2 0.3 0.6	80.0 77.9 81.0	10.90 9.80 10.40	3342 2875 3004
Average. .	43.08	527	16.1	12.8	0.4	79.6	10.20	3074
Rayada	20.76 26.40 17.05	610 590 410	17.6 13.6 12.9	14.1 10.1 8.8	0.2 1.0 1.9	84.1 74.3 68.2	12.4 7.5 6.0	1802 1386 716
Average. ..	21.40	537	14.7	11.0	1.0	75.5	8.6	1301
P. O. J. average.	65.49	660	16.3	12.7	0.8	78.4	10.0	4602

TABLE IV

Average of Results of Eight Crops from Two Plantings *

P. O. J. 36	76.05	840	17.4	14.2	0.5	81.6	11.6	6176
P. O. J. 213	68.88	580	17.0	13.9	0.5	81.8	11.4	5497
P. O. J. 234	47.53	600	17.8	14.9	0.3	83.7	12.5	4159
Rayada	22.49	610	16.1	13.4	0.6	83.4	11.2	1764
P. O. J. average...	64.15	678	17.4	14.3	0.4	82.4	11.8	5277

* All averages in these tables are obtained by adding together the figures for the various years and dividing by the number of years represented, instead of calculating values from the average figures, as for instance, average purity from av. brix divided into av. sucrose.

We find that the *P. O. J. 36* heads the list of varieties, with the splendid average yield for Tucumán of more than 75 tons of cane and 6 tons of sugar per hectare, in comparison with 22½ tons of sugar for the native—a yield, be it remembered, above the average for the *Rayada* in Tucumán in good years. The average chemical analysis of the *P. O. J. 36*, results better than the native. The yield and analysis of the *P. O. J. 213* is very close to that of the *P. O. J.*

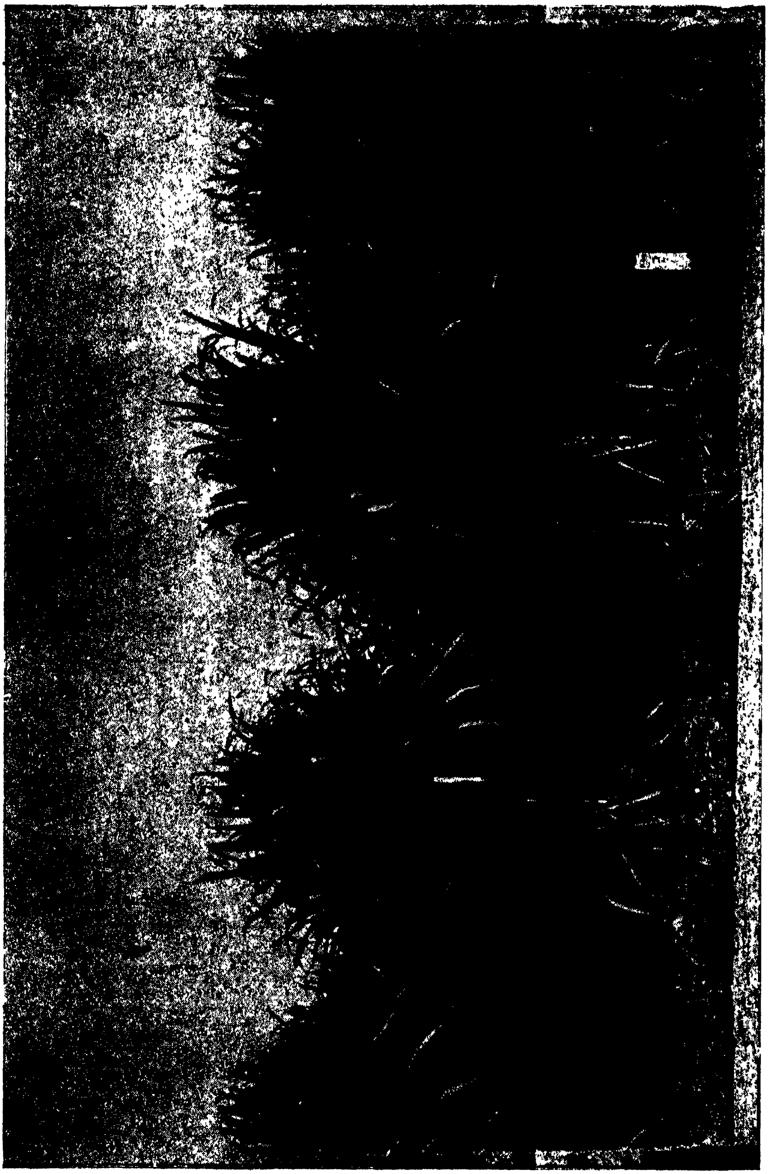

FIG. 4.—The sweetest of the P. O. J. canes—234—in one of the variety plats of the Tucumán Experiment Station

36 and still more than three times the native yield. The juice of the *P. O. J. 234* has maintained its position throughout the test as the richest of all of the varieties and in yield of both cane and sugar per hectare it has exceeded the native *Rayada* by well over 100 per cent.

Definitive Recommendation and Extension of the P. O. J. Canes

After such a long series of experiments and demonstrations in all parts of the Province, during which the most promising varieties had been multiplied in strategic locations so that large-scale planting was immediately practicable, no further doubt could exist as to the superiority of these three *P. O. J.* canes over the native *Rayada* and the other canes tried under Tucumán conditions (69). At the Experimental Station and in the sub-stations, some of which were very large observation fields, we had by 1916 six full years of experience with the new canes under every climatic condition conceivable for Tucumán. The results showed an average yield in cane and sugar per hectare of the three *P. O. J.* canes we have been considering of just about three times that of the *Rayada* yields during the same period and under identical conditions throughout and these results had been confirmed by the large planting of several of the more progressive and wide-awake centrals. The time had come, therefore, for the Experiment Station to make definite recommendations of these canes for supplanting the native striped and purple ones. Early in 1915 an active propaganda was commenced and was duly continued for several years until the planter, large and small, had been induced to leave off the expensive cultivation of the sorely weakened native canes and supplant them as rapidly as possible with the vigorous, rapid-growing Java ones, following the counsels of the Experiment Station officials as to the best of the Java varieties for their particular conditions of abundance or lack of irrigation water, type of soil, etc., etc. With the crop of 1915 practically a complete failure, then—in that year the Province produced less than half of the 263,000 tons of sugar turned out the previous year—the more progressive planters of Tucumán at last put their prejudices and sentiments into their pockets and began to plant the new canes most vigorously, many of them paying enormous prices for seed cane to the still more progressive men who already had large plantings of these varieties established. Some of these latter men made fortunes through their longheadedness. When in 1916 the

FIG. 5—A stool of P O J 36 in Tucumán Experiment Station

average yield of native cane dropped to only about eight tons per hectare, the prejudices against these foreign invaders of their cane fields almost entirely disappeared and some fifty thousand acres of these canes were laid down, the *P. O. J. 213*, as an all-round cane, predominating. The comparatively good development of these plantings in the unprecedentedly unfavorable season of 1916–17, when the native canes, due first to frost and then to drought, practically did not make any growth at all, was the straw that broke the proverbial camel's back and in 1917 everybody fell over themselves to secure seed of the Java varieties, paying almost any price asked by the more fortunate possessors of *P. O. J.* canes, prices of twice the ordinary factory price being paid for seed in train-load quantities with the greatest cheerfulness. It is probable that another sixty thousand acres were planted in 1917, which figure was very little added to in 1918, due to the frosts being so early and so heavy that extremely little good seed was available (105). In 1919 and 1920 the substitution of the Java canes, principally *P. O. J. 36* and *213*, the *P. O. J. 234* being used only for early grinding, since it does not compare with the other two varieties in field tonnage, went merrily on, the last official statistics in 1923 putting the amount of native cane remaining in the Province at 864 acres against 203,162 acres of the Java canes--a replacement of about 99½ per cent. Indeed, today the native canes, as the writer predicted in an address in Buenos Aires six years ago (182), are looked on as curiosities when an occasional specimen reaches the mills, practically always mixed in with cars of *P. O. J.* canes. Such is the blooddless revolution which has taken place in the "Garden of the Argentine Republic" in the comparatively small space of time of less than one decade.

An idea of the magnitude of the reconstruction on some of the centrals which had given no attention to the Java varieties before the disastrous crop of 1915 may be gained from the writer's experience at the Santa Ana estates, the largest in the Province and probably in South America, to take charge of which he resigned the directorship of the Tucumán Experiment Station during the crop of 1916 (27). For that crop the Ingenio Santa Ana had some fifteen thousand acres of cane, not one stalk of which was of the Java varieties. In the following two years we entirely renovated these huge plantations with the Java varieties, and for the crop of 1918 there was not a single stalk of native cane on the entire place.

Incidentally, some of the results obtained from these plantings may be pertinent to this discussion and will be found in Table V. The results from these thirty-five fields represent cane harvested from some one thousand acres during the crop of 1919, a year of serious early frosts, and, hence, of low sugar contents and purities in general, as will be noted in Table V. All fields were ratoons (192.)

TABLE V

Detailed Results of Stubble of Java Canes from 1,000 Acres

Ingenio Santa Ana, Tucumán Province

I.—P. O. J.

Field	Met. tons per hect.	Brix	Sucrose	Purity	Manfg. value	Ks. sugar per hect.
1	77.90	16.7	12.94	76.5	9.90	5,898
2	85.40	16.8	18.61	81.0	11.02	2.781
3	45.45	15.5	11.25	72.5	8.16	2.596
4	55.15	16.8	12.76	78.2	9.98	8,853
5	54.80	14.4	10.97	76 1	8.35	8,178
6	52.40	16.0	12.62	78.9	9.96	8,655
7	68 25	14.0	9.50	67.7	6.48	8,072
8	60.20	12.9	10.94	84 8	9.28	8,841
9	60.20	18.2	9.14	69 2	6.82	2,616
10	46.55	18.6	9.20	67.6	6 22	2,027
11	59.25	15.2	11.78	77 5	9.13	3,787
12	57.55	18.5	8.83	65.7	5 95	2.897
13	52.95	14.5	10.25	70.8	7.26	2,691
14	48 75	16.7	12.86	77.0	9.90	8,089
15	60.25	16.5	12.74	77.2	9.84	4,150
16	58.45	18.6	18.26	71.2	9.44	3,862
17	68.65	17.2	14.15	82.2	11.68	5,182
18	52.20	18.8	9.20	66.5	6.12	2,286
19	57.85	16.2	11.27	69 5	7.88	8,148
20	75 20	14 2	8.68	60.7	5.24	2,758
21	73.10	16.1	12 18	75.6	9.21	4 713
22	71.80	16.1	12.55	77.9	9 78	4,915
Average	58.21	15.4	11.89	73.8	8.50	3,147

II.—P. O. J. 213

Field	Met. tons per hect.	Brix	Sucrose	Purity	Manfg. value	Ks. sugar per hect.
1	39.85	14.4	11.56	80.1	9 26	2,583
2	71.95	16.8	18.69	83 9	11.49	5,787
3	51 80	15.2	11.83	77.6	9.18	8,329
4	51.50	16.1	12.20	75.7	9.24	3,525
5	54 15	16.6	18.05	78.6	10.26	8.889
6	38.00	12.9	8.71	67.8	5.91	1 572
7	51.40	18.5	9.38	69.8	6.51	2,312
8	59.85	13.8	9.22	66.5	6.18	2.568
9	55.55	16 0	11.44	71.5	8 18	8,181
10	58.85	16.8	12.45	76 8	9 50	3.916
11	55.45	14 2	10.82	76 1	8.28	8.194
12	62.85	15.5	12.38	79.9	9 80	4,816
13	44.25	15.9	12.75	80.4	10.25	3,175
Average	53.70	15.1	11.48	75 7	8.77	8,337

These results may be taken as fairly accurately representing the comparative value of the *P. O. J. 36* and *213* all over the Argentine sugar district today, the *P. O. J. 36*, on account of its larger

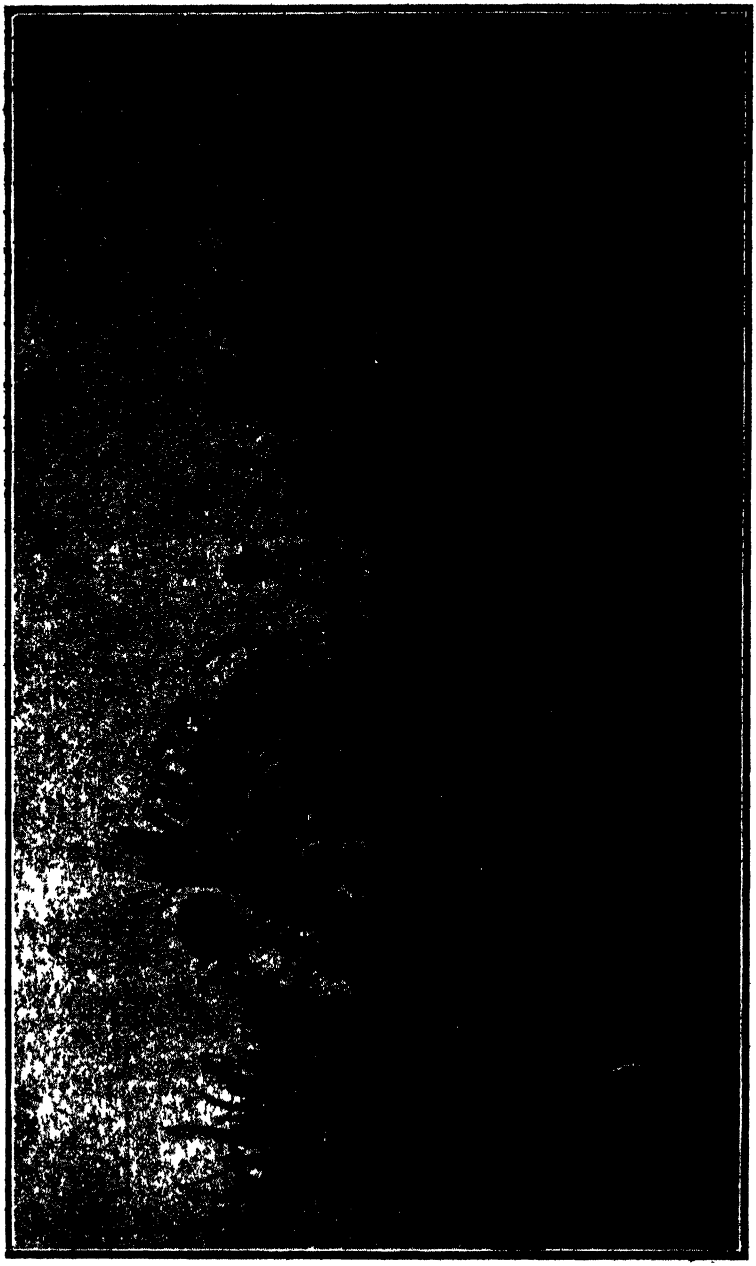

FIG. 6.—P. O. J. 213 on new land at Ingenio Santa Ana, Argentina. This cane is just five months old from planting

diameter and easier stripping, as well as its erectness, having gradually come to occupy first place in the preferences of the planters, although a much larger proportional area of the *P. O. J. 213* was at first laid down, while the *P. O. J.* 234, though an early maturer, is now generally recognized as being a much more delicate cane in every sense than its sister varieties and, hence, over a long series of years, giving a much lighter average yield. *P. O. J.* 234, however, does have the advantage of being a very quick germinater and an erect, rapid grower and, although it has the decided defect of forming numerous adventitious roots, it does not have the drawback of lodging so characteristic of the *P. O. J. 213,* though not of the *P. O. J. 36.* This tendency to lay over, particularly after heavy rains, is one of the few serious points which can be advanced against the *P. O. J. 213.* The *P. O. J. 36* is also rather a quickly germinating variety, but in average richness of juice it is probably slightly inferior to the *P. O. J. 213*, although under normally favorable conditions it can generally be counted upon to offset this condition by giving around a ten per cent better agricultural yield.

Under distinctly unfavorable conditions of any sort, however, neither of the other two varieties mentioned can compare with the *P. O. J. 213* as an all-round cane and for this reason the Argentine planters will do well to always maintain at least half of their plantations in this variety. Under severe drought conditions it is a very slow germinater, but even under the most extreme of such conditions it will not dry out and perish entirely as the *P. O. J. 36* or *234* and with the first rains is up and away as few other canes that the writer has observed.

As regards distinctly unfavorable conditions, the writer has had one experience with hail that he is not likely to forget and which illustrates nicely the extreme resistance of the *P. O. J. 213* to the most unfavorable of conditions. On the 17th of December, 1919, about one-third of the plantations of the Santa Ana estate, which were then almost-ready for the lay-by, were swept away by a hail storm such as the author hopes never again to have the misfortune to witness. The hail lasted exactly twenty-two and a half minutes in the center of the storm and was accompanied by a sixty-mile wind—a veritable tornado—the enormous hail stones coming along almost horizontally and with such force as to leave all brick and concrete walls and even *quebracho* fence posts with southern exposure as pitted as if they had been fired into with machine guns.

After the piled-up hailstones melted, which was not for six or seven hours, in the open fields, *although the maximum temperature that day was 105 degrees Farenheit in the shade,* not a cane stool could be seen standing erect, and two or three days afterwards the entire belt which had been scourged by the hail looked exactly as though a prairie fire had swept over it, leaving not a vestige of green in its wake. Neverthless, with only four months, growth, the *P. O. J. 213* in this zone re-erected itself as if nothing had happened and in the crop of 1920 gave us an average yield of about fifteen tons of cane per hectare, whereas the *P. O. J. 36* did not produce fifty per cent of that quantity. Incidentally, we might state that the stubble of the *P. O. J. 213* recovered perfectly and gave splendid yields again in the next and following crops, while that of the *P. O. J. 36* needed a great deal of replanting to restore it to anything like its original productiveness. Of course this is a very extreme case which is not likely soon, if ever, to be repeated, but all of these points should be carefully borne in mind by the planter who is selecting the basis for his future plantations.

In the Argentine the writer advised the use of the *P. O. J. 213* for very early and very late harvesting and the *P. O. J. 36* in the middle months.

Duration of the P. O. J. Canes as Ratoons

In our opening remarks in regard to the second series of Tucumán experiments, we mentioned the fact that the stronger ratooning canes, such as the *P. O. J.* seedlings and the *Uba,* which were planted in 1910 in the first experiment which we have discussed with these canes, were left growing after the original experiment had to be discontinued on account of the check plats having practically run out, in order to obtain some data as to the probable duration of stubble crops from these stronger varieties. The results of thirteen successive harvests from this original planting—one of plant and twelve of stubble—have recently been published (81) and the data furnish material for an interesting study of the remarkable "sticking power" of the *P. O. J. 36* and *213* under Tucumán conditions—this, be it noted, despite the very large number and intensity of the frosts which have fallen in the province during this long period and despite a 100 per cent Mosaic infection from the planting of the original seed. It should be noted, also, that these results are made all the more striking by the fact that the original planting

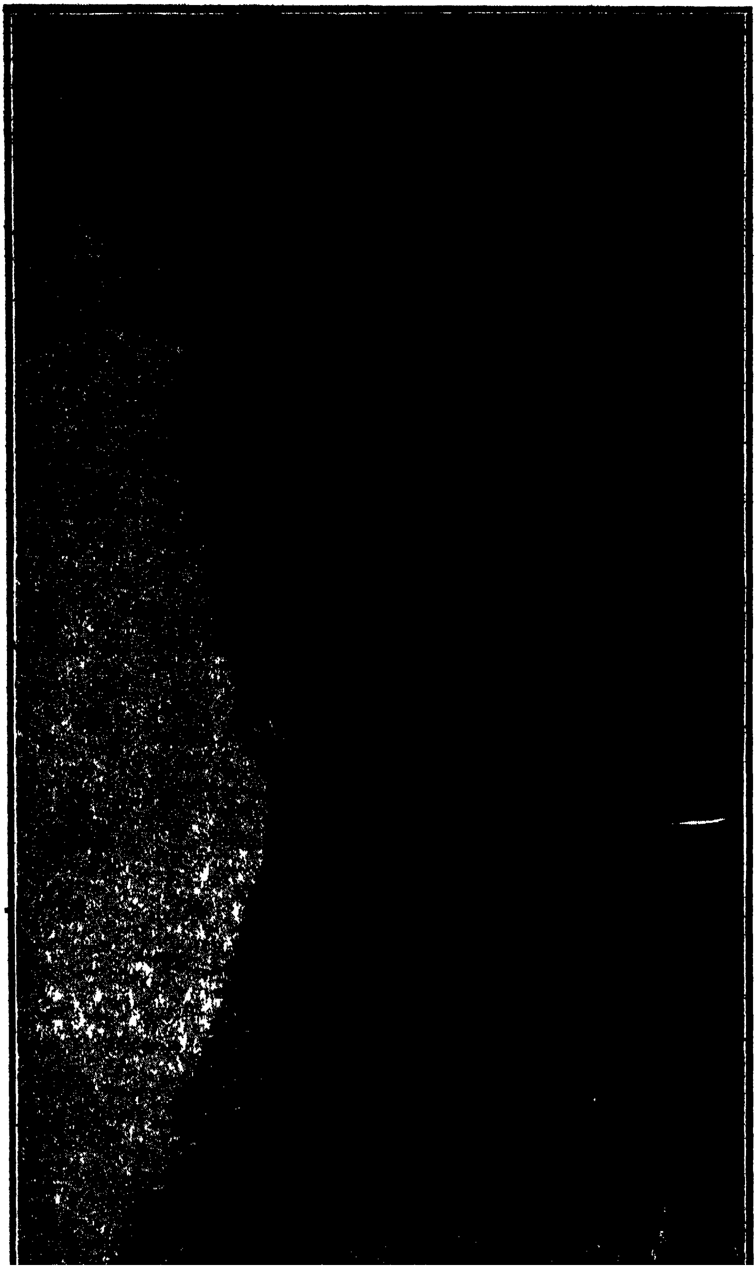

FIG. 7.—First ratoons of the P. O. J. 213 at five months. Ingenio Santa Ana

has never been replanted even to the extent of filling in a single lost stool, nor has this plat received any special cultivation or fertilization—in fact the amount of both have been almost an irreducible minimum. In view of these facts we are inclined to think that the records from this experiment are decidedly unique and that there is little data anywhere covering the yields and manufacturing value of so many successive crops from one original plantation and without any replanting. The writer has run across canefields in various parts of the word whose proud owners claimed that they were fifteen, twenty or even twenty-five years old, but investigation generally revealed the fact that more or less extensive replanting had been done each year or two and it is highly probable that little of the original plantation remained. Most of these cases, in our opinion, are comparable to the case of the man who dilates on the fact that he has had his Ford car for ten years and that it is still "as good as new". It probably is as perfect as the original purchase, but it is also probable that, with the many repairs and replacements, very little of the original car remains besides the radiator cap or the switch key!

In order to avoid a redundance of data, which has already grown rather voluminous, we give in Table VI only the results of the tenth, eleventh and twelfth stubble crops, made at the end of August 1921 and 1922 and early in July in 1923.

TABLE VI

Results from Tenth, Eleventh and Twelfth Stubble Crops from Original Plantings of Java P. O. J. Canes, Tucumán Agricultural Experiment Station

CROPS OF 1921, 1922 AND 1923

Variety	Tons cane per hectare	Average weight per stalk Grams	Chemical analyses of juices			Recoverable sucrose per hect. ks.
			Brix	Sucrose	Purity	
P O J. 36	58.50	520	17.89	15.18	87 00	5800
	57.25	580	19.82	17 02	88 09	6450
	55 00	570	19 78	17.02	86 22	6100
Average	56 92	557	18.81	16 89	87.10	6117
P. O. J. 213	82 00	870	17.74	15 89	86.75	8200
	92.50	470	19.72	17 51	88.79	10700
	56.00	460	20.60	18.48	89.46	6800
Average.	60.17	438	19 85	17.11	88.88	6900
P. O. J. 234	23.50	470	16.89	14.17	86.45	2200
	22.50	500	20 80	18.26	89.95	2750
	28.00	480	20.25	16.78	82.61	3000
Average	24.67	483	18.98	16.39	86 34	2650

TABLE VII

Results from Third, Fourth and Fifth Stubble Crops from Native Striped and Purple Cane Well Cultivated, Tucumán Agricultural Experiment Station

CROPS OF 1921, 1922 AND 1923

Manured	Tons cane per hectare	Average weight per stalk Grams	Chemical analyses of juices: Brix	Sucrose	Purity	Recoverable sucrose per hect. ks.
No	23.87	460	16.67	14.48	86.86	2278
Yes	22.93	460	17.05	11.87	87.21	2246
No	19.80	480	15.59	12.84	82.36	1626
Yes	19.47	580	15.10	12.21	80.86	1505
No	15.87	400	17.98	15.66	87.09	1637
Yes	12.67	390	17.45	15.08	86.41	1253
	19.10	453	16.64	14.19	85.13	1757

A glance at Table VI and a comparison of it with Table I show us that *P. O. J. 36* and *213* have maintained their high standards of production in these very old stubble crops, while the *P. O. J. 231* has dropped very materially in its average yield, in accordance with its earlier record as not such a vigorous cane in any respect as the other two here studied. There will also be noted with all of the three canes a very natural tendency, on account of their remarkable ratooning power, of having a slightly lower average weight of stalk as the ratoons get older. On the other hand the sucrose content and purity of the *P. O. J. 36* and *213* tend to rise directly with the age of the ratoons.

It is difficult to find, therefore, the economical limit of stubble cane for the *P. O. J. 36* and *213* in Tucumán. Undoubtedly it is a poor agricultural practice to leave one crop on the same land for so long a period, but we think it is hardly probable that the average planter would be content to plow out this stubble, even at the age of fifteen years while it continues to give him such substantial and profitable yields with a minimum expense of cultivation, the *P. O. J. 36* and *213* as stubble closing so rapidly that very little cultivation is possible. On the whole, we gather from Table VI that the average results from the last three stubble crops of these canes are slightly better in yield of both cane and sugar per hectare in the case of the *P. O. J. 213* than in that of the *P. O. J. 36*, although the former is susceptible to much wider fluctuations in yield in distinct years than the *P. O. J. 36*.

On the same page with Table VI are given for comparison in

Table VII the results from the third, fourth and fifth stubble crops of native striped and purple cane harvested the same years as the tenth, eleventh, and twelfth ratoon crops of the *P. O. J.* varieties with the results shown in Table VI. A comparison of the average results in the two tables shows how utterly inferior in every respect are the results from these stubble crops from the native cane to these obtained from the *P. O. J.* varieties from infinitely older stubble, although the native cane constituted a series of plats used for testing the value of the native cane UNDER OPTIMUM CONDITIONS.

Cross (85) in 1917 started these experiments with the object of determining if it could be made to give satisfactory yields by employing the best of cultivation methods, heavy fertilization with stable manure, etc., and the giving of the longest possible growing season by late harvesting in years of little frost. As stubble alternate plats were fertilized each year with an application of stable manure at the rate of thirteen tons per hectare. As will be seen from Table VII, the effect of the manure was *nil,* since the unmanured cane gave slightly more cane and sugar per hectare than the manured plats, nor was there any appreciable effect of the manuring on the average weight of the stalks. Of this Cross says:

> "This confirms the results obtained by the Experiment Station in similar experiments from 1910 to 1915 (175) which indicated that the native cane, degenerated from the attacks of Mosaic Disease, does not respond to manuring."

VALUE OF THE P. O. J. CANES TO THE ARGENTINE INDUSTRY

We may safely say, then, that several of the *P. O. J.* canes—*36* and *213* in particular—have saved the Argentine sugar industry from absolute bankruptcy, for no industry could resist the enormous losses which would have had to be sustained had Tucumán not had within its reach the salvation from the ridiculous yields to which its native canes had fallen—if she had not found the remedy ALREADY WAITING FOR HER when ruin was staring her in the face. It is probable that there is not a case in the history of Experiment Stations—and there are some remarkable chapters in that history—where one of the principal industries of an entire section has been so rapidly reconstructed and entirely saved in the short space of seven or eight years.

There is a very common tendency in certain quarters to look upon the work of an experiment station as something extremely and luxuriously theoretical—as interesting, yes, but of slight *practi-*

cal importance. We think that the work of the Tucumán Experiment Station which we have just been discussing may well be used as evidence in refuting any such charge. Let us see, for example, what this one series of varietal investigations alone may mean in dollars and cents in simply the saving in annual expenditures of the Tucumán planters. And the figures here given are not theoretical ones, but are based on the actual costs from thousands of acres of the two distinct types of cane from the time of planting to that of harvest. It is generally conceded in Tucumán that the native cane, year in and year out, costs for cultivation just about twenty dollars per acre—in fact this was for decades the amount universally advanced by the factories to their *colonos* and *cañeros.* The average yield for the native (*Rayada*) *cane, before the last series of disastrous years,* was but a little over eight tons per acre. That means, therefore, that the cost of cultivation of the *Rayada* cane PER TON was about $2.25. We have seen that the *P. O. J.* canes are quicker growing and, hence, need less weeding and general cultivation, while yielding from twice to four times as much as the native cane. Let us take as a conservative figure only twice the yield of the native cane and assume that we will spend 80 per cent as much in cultivation per acre, a figure which should never be realized, as the Java canes are actually cultivated at a much lower rate than this. This means, then, reduced to *cost per ton,* that the Java canes cost for cultivation a little under one dollar per ton, whereas the Tucumán planters have been in the habit of spending $2.25 on the native cane. The Tucumán planters, then, are today saving in cost of cultivation at least $1.25 on every ton of cane they deliver to the factories. In her last crop the Province of Tucumán ground slightly over three million tons of cane, which would work out at an annual saving of over three and three quarter millions of dollars in cost of cultivation of the area required to produce this amount of the *Rayada* cane even were it possible to produce it—and the annual cost of the Experiment Station to the Province has been about 1 per cent of this amount!

THE SO-CALLED EGYPTIAN CANE—P. O. J. 105

P. O. J. 105, one of the same series of canes which we have been discussing, all produced by crosses of *Cheribón* (our Porto Rican *Rayada* is the *Striped Cheribón*) and *Chunnee* by Kobus in Java, was introduced into Egypt many years ago by the Societé Générale des Sucreries d'Egipte, which company holds practically the mo-

nopoly of the Egyptian sugar industry, and is by no means, as has been more or less commonly thought, indigenous to that country.

Under date of 10th of May, 1913, the Societé Générale des Sucreries in a letter to Messrs. Hileret & Co., owners of the "Santa Ana" estates in Tucumán, gave us the following information about this variety:

"It is remarkable for its elevated production and its surprising rusticity, which resists better than any other the fluctuations of climate and irrigation. Foliage abundant, sugar content generally equivalent to that of the '*rubanée du pays*', *i. e.*, between 13 and 14½ per cent, but its maturity is generally one or two points lower. Nevertheless it will produce an amount of extractable sugar per hectare superior by 30 to 60 per cent to the other varieties here. We can easily obtain with the *P. O. J. 105* a yield of 115 tons of cane per hectare, with 10 to 10.25 per cent white sugar bagged, in spite of the fact that in Egypt we have but an eight-month growing season.

"Its defects are, (1) quick inversion after cutting, which means organization for quick deliveries and grinding, and (2) greater difficulty in stripping than with the other varieties. However, we consider that its advantages considerably outweigh its defects."

About this time this variety was introduced, as "Ambar de Egipto", into the Province of Tucumán by the Nougués Brothers, propietors of the San Pablo factory and plantations, and the material for trial at the Sugar Experiment Station of Tucumán was obtained from those gentlemen. In the characteristics of this cane we find much in common with the other canes of this series, as it is a tall-growing, thin type of cane of vigorous development and high ratooning qualities. In Tucumán and in Egypt the characteristic stalk color is amber, a color quite common in the younger canes here in Porto Rico, but after the older canes have suffered exposure to the sun they become a rose color somewhat similar to that of *P. O. J. 36*, although quite a number of stalks are found of a green shade very similar to that of the *P. O. J. 234*, with both of which canes this variety is sometimes confused. The buds, however, are quite distinct for the three varieties, as may be seen from a study of the illustration of the same in this publication. Generally the stalks are rather heavily coated with wax in the *P. O. J. 105*.

In the first few years after its introduction the *P. O. J. 105* received a great deal of attention from planters in the Province of Tucumán, Nougués Brothers very rapidly extended their acreage—as, incidentally, they had previously done with the *P. O. J. 100*, only to have to destroy it later on when it was found that it suffered very severely from Mosaic attack—reporting lower fibre

content and higher percentage of sugar for the *P. O. J. 105* than for other *P. O. J.* canes, and requests to the Experiment Station for seed were many and beseeching. The fond hopes founded on this cane, however, were never justified in Argentina, for, while careful experimentation at the Station proved it to have many very excellent qualities, it never made a showing which would permit it to compete very seriously there with either the *P. O. J. 36* or *213*.

When the writer left the Argentine, Nougués Brothers, in spite of our rather indifferent results with *P. O. J. 105* at the Experiment Station, were still multiplying their plantings of this variety, and a number of other factories and planters were following suit in a minor degree. The writer recently wrote to Dr. W. E. Cross, who succeeded him as Director of the Experiment Station and to whom he wishes to express his appreciation of the valuable information furnished him for this paper, requesting data upon the plantings of the *P. O. J. 105* at San Pablo and other places where this variety was rather popular several years ago. Dr. Cross was kind enough to send us a letter which he had received in answer to his inquiry from Engineer José Padilla, Manager of Ingenio San Pablo, in which he states that "We have been obliged to replace it with *P. O. J. 36* and *213* to such an extent that we now have only about ten hectares of the *P. O. J. 105* left on our estates."

We received the *P. O. J. 105* at the Tucumán Experiment Station in 1914 and observations on it have been made constantly since that time. It was planted in three distinct lots in 1914, 1916 and 1917, the results of which Cross has recently published. We give below the results of second, third and fourth ratoons, from the crops of 1919, 1920 and 1921, as Table VIII, a comparison of which with Tables I, III and VI will demonstrate that, while this variety has given satisfactory cultural results, it is decidedly inferior to the other *P. O. J.* canes.

TABLE VIII

P. O. J. 105 in Tucumán

[Second year stubble on first line (1919), third and fourth year successively]

Metric tons cane per hect	Average weight stalks Gms.	Chemical analyses of juices					Kgs. of sugar recoverable per hectare
		Brix	Sucrose	Glucose	Purity	Mfg. value	
55.05	560	19.84	15.88	0.20	79.26	18.70	3,771
34.60	520	14.98	11.81	0.68	75 50	9.85	2,385
34.15	510	15.86	12.16	0.67	79 15	10.50	2,605

Innumerable experiments by Cross (63) failed to prove the much talked-of early maturing qualities of the *P. O. J. 105*, as compared with the other canes of this series. In 1920 and 1921 most exhaustive tests were made to study this all-important point, analyses of several of the more promising canes being begun each year late in March or early in April (crop in the Argentine commences the latter part of May or early in June) and repeated each week from the same plats. The writer knows of no more complete maturity studies anywhere than those made by Cross in this series of tests. The data is very voluminous, only half of those for the year 1921 being given here, as Table IX.

TABLE IX

Ripening of the P. O. J. Canes in Tucumán

Alternate Weekly Analyses, made at the Sugar Experiment Station

P. O. J. 234, THIRD RATOONS; OTHERS, FOURTH RATOONS

P. O. J. No.	Brix	Sucrose	Glucose	Purity
		8th of April		
36	13.76	10.58	1.24	76.88
105	13.31	9.52	1.19	71.52
213	13.91	11.39	0.76	81.88
234	17.07	14.90	0.57	87.33
		22nd of April		
36	15.37	11.94	0.94	77.68
105	16.07	12.34	0.40	76.68
213	14.57	11.93	0.72	81.88
234	18.38	16.11	0.45	87.64
		6th of May		
36	15.93	12.88	0.75	80.85
105	14.43	10.87	0.67	75.32
213	16.68	14.28	0.67	85.81
234	18.38	16.22	0.29	88.24
		20th of May		
36	17.24	14.81	0.47	85.90
105	15.47	12.34	0.47	79.76
213	16.94	14.55	0.12	85.89
234	18.27	16.59	0.18	90.80
		3rd of June		
36	16.91	14.09	0.24	83.32
105	16.56	13.61	0.29	82.18
213	18.15	16.18	0.18	89.14
234	18.75	17.17	0.13	91.57

From these very complete results it may be readily appreciated that the *P. O. J. 105* is not only far from such early maturity as the *P. O. J. 234*, which is a notably early-maturing cane, but is also consistently inferior to both *P. O. J. 36* and *213*, not only in earliness of maturity, but in sugar content and purity as well.

THE P. O. J. CANES IN PORTO RICO

It would appear that to Prof. D. W. May of the Federal Experiment Station in Mayagüez is due the credit for the introduction of most of the *P. O. J.* canes we are considering in this paper into "The Isle of Enchantment." From the Sugar Experiment Station

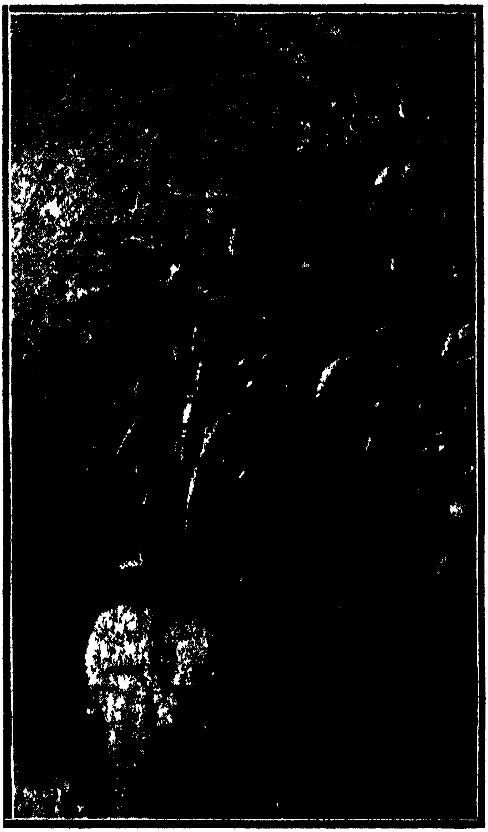

FIG. 8.—P. O. J. 36 in Porto Rico. A splendid field at Central "Los Caños"

in Tucumán we sent in 1915, along with the first sending of *Uba* cane, which was afterwards repeated on a hitherto unprecedented scale (57), *P. O. J. 36* and *234*, and in 1921 the Tucumán Station sent a few seeds of the *P. O. J. 213* to the Insular Experiment Station of Porto Rico. It would seem (101) that the *P. O. J. 105*

was brought from Egypt by Mr. May a number of years ago, although little attention was paid to it until after the discovery by Earle of its extreme resistance to Mosaic Disease and, like the other three *P. O. J.* canes here considered, to root diseases, although in both cases it shows more effects of disease than either the *P. O. J. 36* or *213*. Mr. Antonio Fraticelli, manager of Central "Los Caños," to whom the author is indebted for a large part of the data which he has been able to obtain on the Java canes in Porto Rico, tells us that, when he went as manager to Central "Córsica" in 1917, he found a few stools of the *P. O. J. 105* which had been practically abandoned. Struck by its good development with practically no attention being given to it in a cultural way, he began extending this cane and, as passing planters began to notice its growth and appearance, he received many requests for seed, which were generally granted. It is very probable, from what we have been able to discover, that the wide extension of this cane in Porto Rico dates from the finding of these stools by Mr. Fraticelli.

Despite the fact that there are large areas of the *P. O. J. 105* planted all over the Island, with smaller amounts in order of their naming of *P. O. J. 36, 213* and *234*, it has been very difficult to obtain data from plantings of these canes in comparison with each other or with other standard canes. Naturally, isolated data of yields or chemical analyses without some basis of comparison with another variety under similar conditions are of very doubtful value in forming an opinion of the relative merit of any cane varieties: hence the amount of data furnished on these canes in Porto Rico may appear to be rather disappointingly small.

Mr. May has kindly furnished the following data of yields from the Mayagüez Experiment Station, the cane being 16–17½ months plant: *P. O. J. 36*, 5213 tons peracre; *105*, 42 tons; *132* 54.9. Mr. E. H. Barrow sent us the following:

TABLE X

Yields of Cane Varieties, Central Pagán, Añasco, 1924 Crop

Hacienda	Variety	Class	Tons per acre
Altagracia	P. O. J. 36	Gran Cultura	45.0
Trinidad	P. O. J. 36	1st Ratoon	18.8
Pagán	B. H. 10 (12)	3rd. Ratoon	35.5
Pagán	P. O. J. 105	1st. Ratoon	35.0
Cipriana	P. O. J. 105	1st. Ratoon	30.0

Mr. R. L. Page, manager of cultivation for Russell & Co., wrote under date of 16th January, 1924, regarding the *P. O. J. 36* around Añasco, as follows:

"We have been farming this cane in Añasco for the past three years and find that under reasonably good conditions it gives from 40 to 50 tons as ratoons.

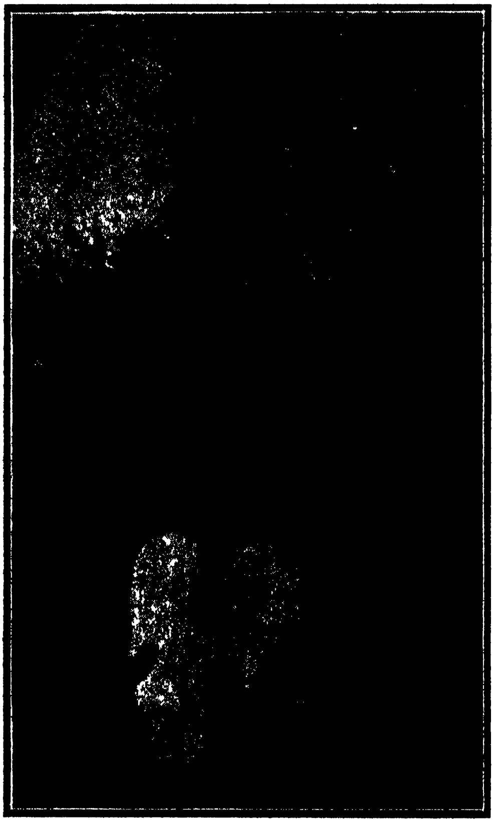

FIG. 9.—P. O. J. 213 at "Los Caños"

We have cut second ratoons as high as 38 tons. This cane is somewhat sweeter than the *Uba* cane and when left to reasonable maturity ranges between 13 and 16 per cent sucrose."

Mr. Fraticelli has been kind enough to furnish us the following comparative yields from "Los Caños":

TABLE XI

Comparative Production at Central "Los Caños" of Rayada and P. O. J. Canes

GRAN CULTURA

Dist. 1	Rayada	33.75 tons per acre	P. O. J. 105	50.05 tons
Dist. 2	Rayada	18.40 tons per acre	P. O. J. 36	41.85 tons
Dist. 3	Rayada	14.15 tons per acre	P. O. J. 105	49.93 tons

Mr. Fraticelli has also put at our disposition a number of comparative analyses from Centrals "Coloso" and "Los Caños." The following represents an average of three analyses each of *P. O. J. 36* and *105*, "gran cultura" from Finca Carlota near Rincón, ground in Central "Coloso" in January of this year and an average of two analyses of *P. O. J. 234* "gran cultura" of the same origin and ground in the same Central in February.

P. O. J.	Sucrose	Purity
36	16.86	85.06
105	15 06	85.28
234	16.08	85.27

The following analyses were made at "Los Caños" of "gran cultura" cane on the 23rd of January last; all from good lowlands:

Variety	Brix	Sucrose	Purity
Rayada	14 84	12.15	81.90
P. O. J. 36	17.12	14.98	87.51
P. O. J. 105	15.03	12.44	82.87

The next two analyses were made at "Los Caños" the next day:

P. O. J. 36	16.84	14.37	85.25
P. O. J. 105	15.81	12 48	78.60

Finally, through the kindness of Mr. Andrés Oliver, of Central Cambalache, the writer secured the following comparative analyses of twelve-month plant cane made in that central on the 3rd of April last:

Variety	Brix	Sucrose	Purity
P. O. J. 105	18.00	14.87	82.61
P. O. J. 213*	16.65	14.33	86.07

* Called *36* at Cambalache.

CONCLUSIONS

From the small amount of data on cultural yields and chemical analyses which we have been able to obtain under comparative Porto Rican conditions, we find that on "The Isle of Enchantment", these four *P. O. J.* canes seem to have behaved in a manner surprisingly

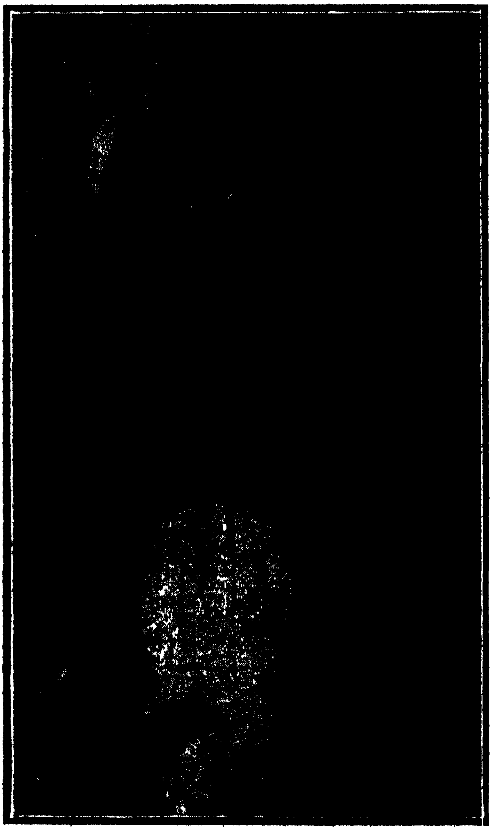

FIG. 10. — D. Antonio Fraticelli, manager of Central "Los Caños", in one of his prize fields of P. O. J. 36

similar to that displayed in Tucumán. In Tucumán we found that the *P. O. J. 36* and *213* had outdistanced all other canes in yield of cane and sucrose per acre, as well as in resistance to their 100 per cent infection with Mosaic Disease and to various root diseases. As an early maturer *P. O. J. 234* was superior to all others, but its

cultural yield was never as high, nor does it last in Argentine so many years as stubble. The *P. O. J. 105* in all Tucumán tests certainly stood at the bottom of three other sister canes in point of cultural and factory yield, long ratooning, maturity and resistance to Mosaic and other diseases. A glance at the Mayagüez results

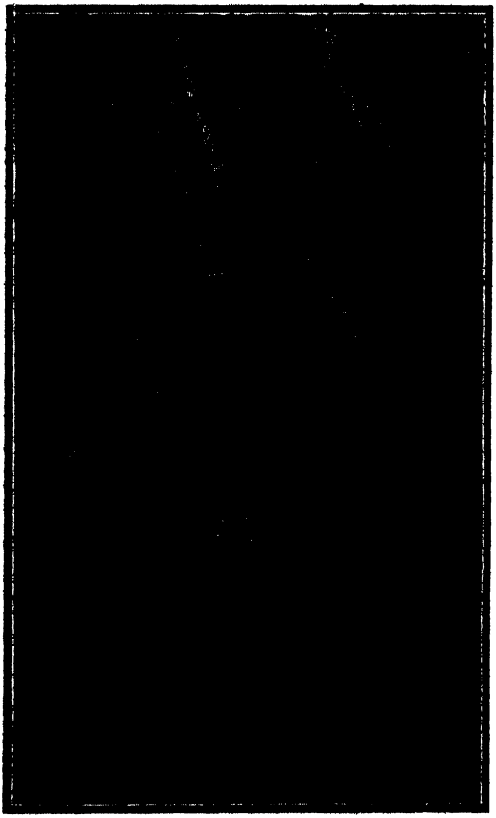

FIG. 11.—Ratoons of P. O. J. 234 at Central "Los Caños", Arecibo. Note adventitious roots characteristic of this early-maturing variety

will show that *P. O. J. 36* and *213* have outdistanced the "Egyptian" in yield of cane per acre by over 10 and 15 tons, respectively, while the highest yield recorded in the field from Añasco is also for the *P. O. J. 36*. While actual comparative data is lacking from "Los Caños", personal inspection by the writer has shown both the *P. O.*

J. 36 and *213* to be superior to the *P. O. J. 105* in general condition in the field. The "Coloso" analyses of *P. O. J. 36, 213* and *234* show that the *P. O. J. 105* has over a point less sugar than the other two varieties, while the "Los Caños" analyses show the *P. O. J. 36* about two points in sugar and over five points in purity ahead of the *P. O. J. 105*. Finally the Cambalache data show a superior purity of some 3½ points for *P. O. J. 213* over *P. O. J. 105*.

Why, then, is the so-called "Egyptian" cane so much more extensively cultivated in Porto Rico than any of the other three varieties, particularly the *P. O. J. 36* and *213?* The answer is hard to find except upon the grounds that the seed of the former was more easily obtainable when interests was awakened in this class of cane at the time of the outbreak of Mosaic on the West Coast and planters have learned to know this variety while seldom seeing the others herein discussed.

A Word of Warning

The writer would certainly advise Porto Rican planters cultivating the *P. O. J. 105*, or "Egyptian" cane in Mosaic Disease sections to at least try out the other three *P. O. J.* varieties discussed in this paper under the conditions of their own particular properties and in direct competition with each other, as well as with other varieties in the trial of which they might be interested. The data obtained in both Argentine and Porto Rico would certainly indicate that they are cultivating about the poorest of the prominent *P. O. J.* canes and if they verify this indication in their own fields the course to follow will be plainly seen. The cost of cultivation is about the same for these canes whether one obtains a large crop or a comparatively small one and an extra yield of ten or fifteen tons per acre so enormously reduces the ton cost of cultivation that it would seem that such trials would be well worth while.

However, the writer wishes to point out most unequivocally that HE IS NOT RECOMMENDING ANY OF THESE CANES FOR CULTIVATION WHERE AN EFFORT IS BEING MADE TO CONTROL MOSAIC, as all figures herein given for the *P. O. J.* canes are for cane *100 per cent infected with Mosaic*. While Mosaic does not seriously affect the vigor of these particular canes, their introduction into comparatively clean areas would be fatal, as they would serve as foci of infection for all surrounding fields. There are, however, considerable extensions of territory in the earlier infected sections of the

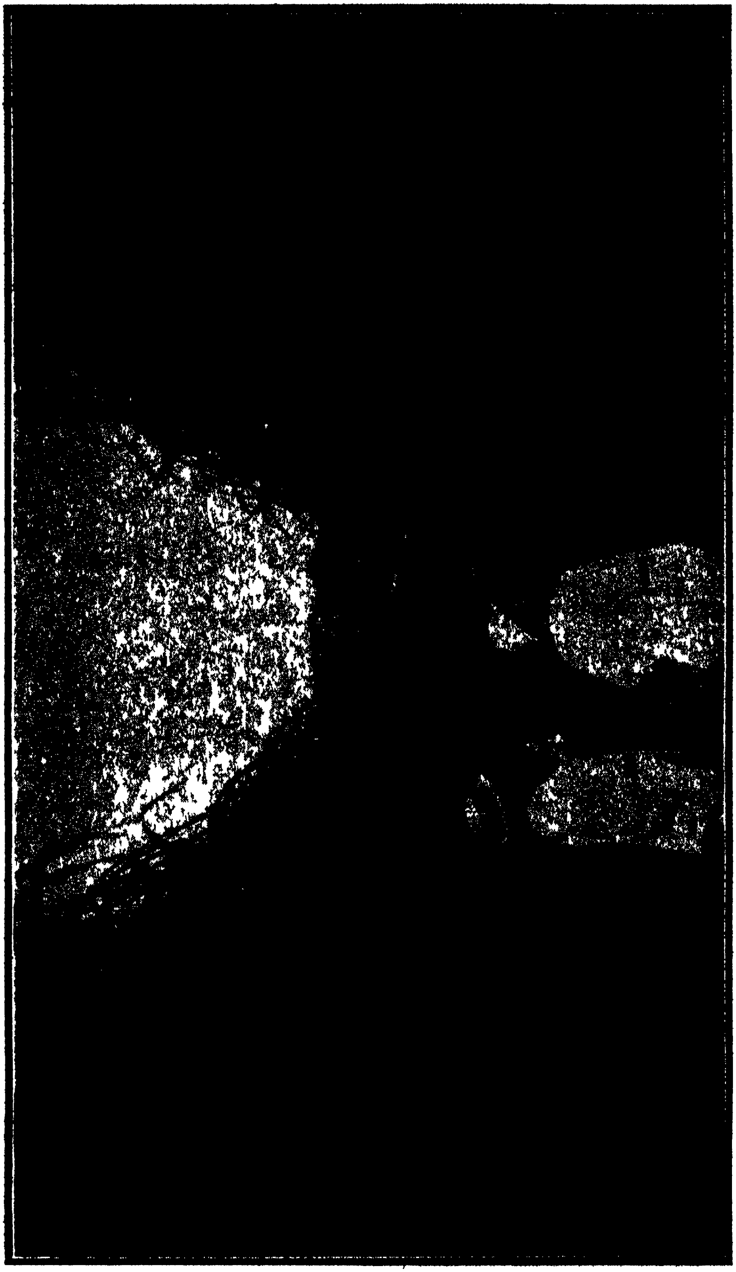

FIG. 12.—Looking down a road between two remarkable fields of P. O. J. 36 at Central "Los Caños"

Island where planters have decided to follow the same policy as was followed in Argentine in solving its Mosaic Disease problem—*i. e.*, planting only the tolerant varieties and eliminating the susceptible ones. In such districts—AND IN SUCH DISTRICTS ONLY—we can thoroughly reccmmenended a trial of the lesser-known *P. O. J. 36, 213* and *234* canes and if results prove that any or all of the three, under the particular conditions of the experiment, are superior to the *P. O. J. 105* already in cultivation, then it would seem the part of wisdom and common sense to gradually replace the *P. O. J. 105* with the higher yielding, sweeter, hardier and more early maturing variety or varieties indicated by such tests. We have seen that the *P. O. J. 36* and *213* have meant millions of dollars in the pockets of the Argentine planters and central owners—it is by no means impossible that they may have a similar significance for Porto Rico.

APPENDICES

A. The Fiber Content of the *P. O. J.* Canes and its Significance.
B. Descriptions of the *P. O. J.* Canes Discussed in this Paper
C. An Annotated Bibliography of *P. O. J.* Canes.

APPENDIX A

THE FIBER CONTENT OF THE P. O. J. CANES AND ITS SIGNIFICANCE

A frequent objection that is made to the *P. O. J.* canes is the difficulty of milling them on account of the higher fiber content, as compared with the *Rayada* or *Cristalina* type of cane. On the other hand, many persons of experience consider that the higher fiber content of these canes, instead of being a disadvantage, is a very decided point in their favor, taking into consideration the increased resistance of the higher fiber-content canes against the attacks of the common moth cane borer, *Diatraea saccharalis*, and the additional amount of *bagasse* supplied by these canes for the furnaces.

The following table gives the fiber contents of the four *P. O. J.* canes discussed here, in comparison with the *Rayada*. All but the analysis of the *P. O. J. 105* which was made by Mr. Francisco López Domínguez, Chief Chemist of the Insular Experiment Station, represent the averages of a number of fiber determinations made at the Tucumán Sugar Experiment Station.

FIBER CONTENTS

Variety	Per cent fiber in canes
P. O. J. 36	12.80
105	13.27
213	13.00
234	12.20
Rayada	10.60
Average P. O. J.	12.82

In will be observed that all of the Java varieties run very considerably higher in fiber than the *Rayada*, averaging a 21 per cent increase.

EFFECT ON BORER INFESTATION

The increased fiber content of these canes, which is particularly manifested in additional hardness of the rind and internodes, makes penetration into the inner tissues of the cane by the moth borer a very much more difficult matter than in such canes as *Rayada, Cristalina* or *Santa Cruz 12* (*4*) and, probably more important yet in its effect on the composition of the juice and in the reduction in

extraction which follows heavy borer attack, is the fact that, whereas the borer, once its tunnel is started in the softer canes, will perforate several joints, in these harder canes it has been found that, in stubble cane particularly, they seldom pass the node immediately above them and their attacks, hence, are in the majority of cases

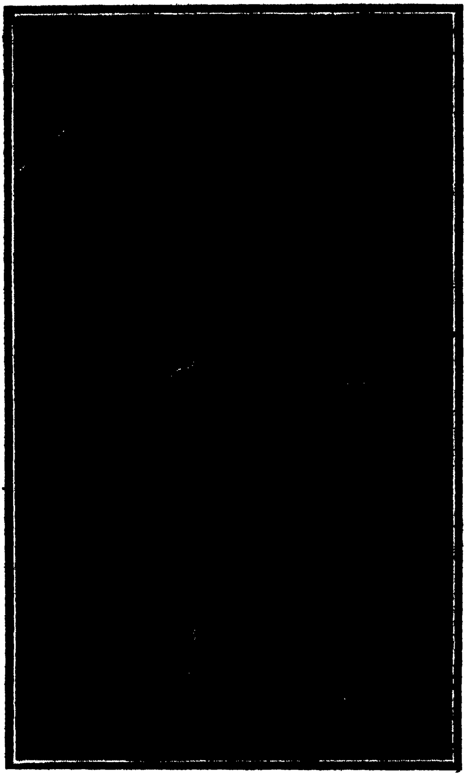

FIG. 13—Java 36 (P. O. J.)

confined to one joint. In Tucumán we found that the average joint infestation with *Diatraea* in the native *Rayada* type of cane was 41.3 per cent over a series of years, while that for the *P. O. J.* canes *36*, *213* and *234* averaged just about 15 per cent. Barber (8) gives a large number of comparative analyses from the Audubon Park Experiment Station showing a great reduction in the manu-

facturing value of cane juices from severely attacked canes and Van Dine figured out this loss in Porto Rico at 670 pounds of sugar per acre. Using Van Dine's figures as the average for the Island, Jones (141) figured out an annual loss to the Porto Rican sugar growers at over 32,700 tons, which, calculated at but $77.50 per ton, would represent a value of over two and one-half millions of dollars. Could we cut this loss down in the same proportion as the *P. O. J.* canes are less infested with borer than the thicker, softer canes—over 60 per cent on the average—it well be seen that the acre-profit would be quite substantial.

Effect on Milling Results

Despite the many opinions to the contrary which one frequently hears expressed, there is no doubt that, with proper adjustment of the crusher rolls and the necessary changes in the feed to meet the conditions of a thinner cane with decidedly higher fiber content—which means, of course, that a layer of the P. O. J. cane of the usual depth on the conductor will contain more fiber and, hence, offer more resistance to the mills than is indicated by the comparison of the fiber contents of the *P. O. J.* canes and the *Rayada* or *Cristalina*, since the thinner canes fit more closely together and a considerably greater *weight* of cane will pass over the conductor than with the same thickness of layer of the thicker canes—very good milling results can be obtained from these canes, although their higher fiber content does undoubtedly signify a certain amount of reduction in the grinding capacity per hour of any properly adjusted milling plant and a probable small decrease in extraction under normal conditions (169).

In studying this question, the writer a number of years ago, making use of the very complete Mutual Control Reports from Java, complied the comparative manufacturing figures for two sets of sugar mills in that progressive island—one lot representing the twenty-three plants which for the entire crop of 1912 ground cane with an average fiber content of above 13 per cent, corresponding to the content of the *P. O. J.* seedlings we have been discussing, and the other representing the 17 factories which that year ground cane averaging less than 11 per cent fiber, which compares quite well with our *Rayada* and *Cristalina*. The results found in the Table below are extremely interesting.

TABLE XII

Results Obtained in Java from Factories Grinding Cane of High and Low Fiber Content

Fiber in cane	No. Factories	% sucr. in cane	% sucr. extracted on 100% cane	% juice extracted on 100 parts juice	Fiber in cane	Bagasse da %		
						Sucr.	Moisture	Sucr. lost
Bellow 11..........	17	12.59	11.49	91 8	10.58	4.72	48 45	1.10
Above 13	28	12.25	11.06	90.8	13.61	4.29	44.99	1.1

There was little difference, then, between the results obtained by the two groups, the most important one from the calorific standpoint being that the *bagasse* from the high-fibered cane had 3½ points less humidity than that from the mills grinding canes of low-fiber content. The average per cent sucrose in cane was slightly better in the group of centrals grinding low-fiber cane and they obtained one point better extraction than the mills grinding cane of high-fiber content, losing, also, slightly less fiber in the *bagasse*.

This table seems to make further discussion of the milling of the *P. O. J.* canes unnecessary as mechanical practices, unlike agricultural ones, can be pretty well applied in any country and there is no satisfactory reason why milling results achieved with these canes in Java should not be duplicated in the very well equipped centrals of "The Isle of Enchantment".

APPENDIX B

TECHNICAL DESCRIPTIONS OF THE P. O. J. CANES

Very shortly after the recognition of the fertility of cane seed in 1888–89 by Harrison and Bovell in Barbados and Soltvedel in Java, working completely independently, extensive breeding of varieties was commenced by Kobus and Wakker at the Oost Java Proefstation, the Indian cane *Chunnee* (one of the *Ukh* class) being employed as the male parent and the *Black Cheribón* and *Striped Preanger* (our *Morada* and *Rayada*) as the female. This combination was used with the object of obtaining a "hybrid" with the sereh-resistant qualities of *Chunnee* and the very desirable cultural and manufacturing characteristics of the female parents, then in common cultivation in Java. All of the four canes which we have been discussing belong to this series and partake of the characteristics of the majority of the varieties produced by these crosses, *i. e.*, they all have narrow leaves, long thin joints, extremely hard rind and a modified central fistula. The following short descriptions are based on those of Jeswiet (138–9) and Fawcett (109). The colors mentioned therein refer only to the mature cane and the male parent is given first in each case in referring to the parent canes.

P. O. J. 36. Chunnee X Striped Preanger.—Stalk light-green yellow, overlaid with rose, later with rose splashes. Numerous rind fissures visible as rose-colored stripes, no growth fissures. Wax layers distinct in younger joints, later remaining as black patches. Joints very zigzag, cylindrical concave on eye side, convex on opposite, 5 mult 1 inches. Pith dense, coarse, with small fistula. Rind very thick and hard. Growth ring very wide, horizontal, bulging slightly above eye, often with a rose-colored border. Root ring inverted cone or cylinder, 2–3 rows of roots, dark yellow, often ringed purple. No eye channel. Eyes broad, almost elliptical, compressed, upper part wide, lying close to the stalk. Germinating point nearly central, nervature almost radial. Group hairs 1, 2, 3, 4, 7, 8, 10, 12, 14, 18, 19, 21 constant; 5, 6, 11, 22, 25, variable. Leaf sheath 12 to 13 inches long, with small, inconspicuous ridge. Inner auricle always and outer sometimes present. Ligule broad, bow-shaped over eye. Leaf dark green, 3.9–4.1 cms. wide, leaf callus olive green,

with yellow margin. Group hairs 51, 52, 53, 54, 57, 58, 60, 61, 64, 66, 70, 71.

P. O. J. 105. Chunnee X Black Cheribón.—Old stalks rose-colored under wax layer, the color being diffused and disposed in indistinct fine lines over brown base. Due to the thick wax coating this color appears to be a clear grey or almost violet, the character-

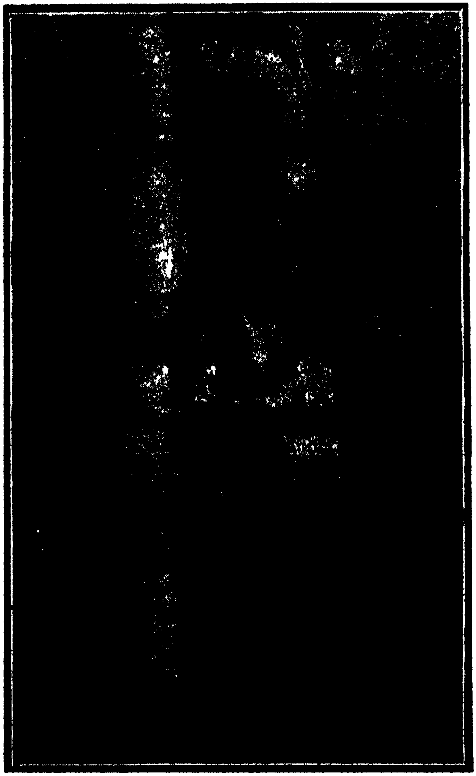

FIG. 14—Java 105 (P. O. J.)

istic color of this variety. Pruinose ring notable for its entire lack of red color and for its slight construction. Joints somewhat zig-zag, long, the younger ones cylindrical; in the older ones the eye side is straight and the opposite side slightly convex, the lower joints being somewhat inversely conical. Pith dense, with thick fibers. Rind hard, but not so thick as in the *P. O. J. 36.* Growth ring with fundamental color of joints, sometimes slightly constricted,

but never swollen. Root ring somewhat narrower at the top in the upper joints and convex and swollen in the lower ones; rudimentary roots almost same color as the base on which they appear, this being of a dark red color in the middle joints. The color of this zone is at times rather rosy and becomes darker upon exposure to light; also covered with wax; rudimentary roots tenuous and persistent. Well developed eyes broad, elliptical and compact, upper part widely alate and slightly pointed, the angle of the germinating point obtuse and the edges of the "wings" slightly dentate. The eyes just exposed to the sun are purplish toward the germinating point, which is found at the upper center of the eye. At first the buds are flattened, later becoming convex. The interior edge of the "wing" has some small hairs (4), with groups in the exterior angles (26). The "wing" itself is covered with short, fine, black or white hairs (12), while the basal belt (1 and 2) of white hairs is always present, although the hairs are relatively sparse. Nervature free of pubescence. In the exterior angles of the "wing" covered with short black hairs (21), these also being found on the upper part of the eye (23), where they are mixed with long white hairs (10). At the base are found at times external* groups, (19) which combine with group 18. Groups 1, 2, 16, 4 of the external side and 18 and 19 of the internal are almost always present, the others at times being lacking. Leaf sheath dark green, pruinose and smooth except at base, where there are occasionally found some short hairs (58). Leaf scars oblique. Inner auricle lacking, exterior small (5 mm. in length) or lacking. Ligule narrow. Ring yellowish or greenish, with fine white or black hairs, which unite with the groups which are found on the nervature and which are not numbered. Leaf dark green, long and narrow, basal leaf callus green and covered with fine white pubescence (52). The hairs are longer along the edge (51) on the upper side. The lower side, besides being pubescent (58), is somewhat pruinose.

P. O. J. 213. Chunnee X Black Cheribón.—Stalk dark purple to brown red. Rind fissures in older joints, no growth fissures. Wax layer at first plain and thick, diminishing with age, wax ring sharply defined. Joints slightly zigzag, cylindrical, slightly concave on eye side, convex on opposite, 6 to 9 by three-fourths to one inch. Pith smooth, often with a fistula, rind hard. Growth ring horizontal, wide, smooth, yellow splashed with red. Root ring cylindrical, more or less concave, broader than stalk, dark brown,

2 rows of roots. Eye channel almost always absent, distinguishable in older cane as a flattening. Eye elongated egg-shaped, triangular point, broad wing, very flat, germinating point apical, nervature converging to top. Hair groups 1, 2, 12, 19, 21, and 26 constant, 10 and 11 variable. Leaf sheath 11 inches long with fissures one-half inch long. Auricle almost always absent, small and stumpy.

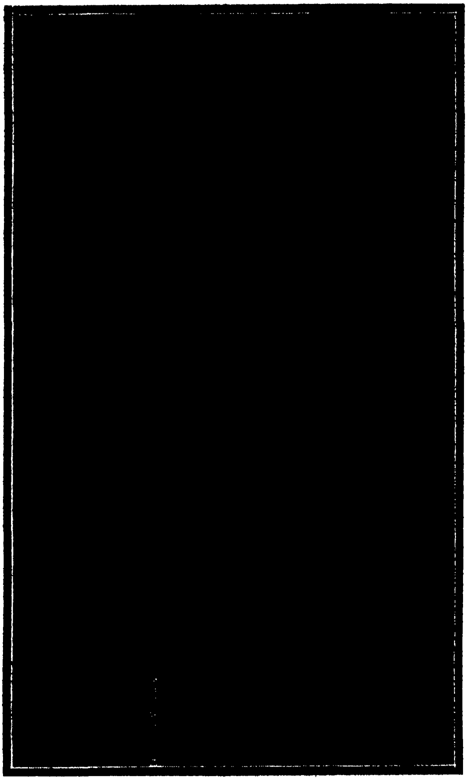

FIG. 15.—Java 213 (P. O. J.)
Central Cambalache

Ligule very wide and smooth. Leaf $1\frac{1}{2}$, inch wide, callus yellow-green, waxy. Hair groups 51, 52, 53, 54, 57, 60, 61 and 62.

P. O. J. 234.—Lowler joints green tinged with purple, upper yellow-green with thin brown striping, wax layer thick. Rind thinner than in other canes above described. Growth ring bronze where exposed and pale green or yellow in upper joints. Two or

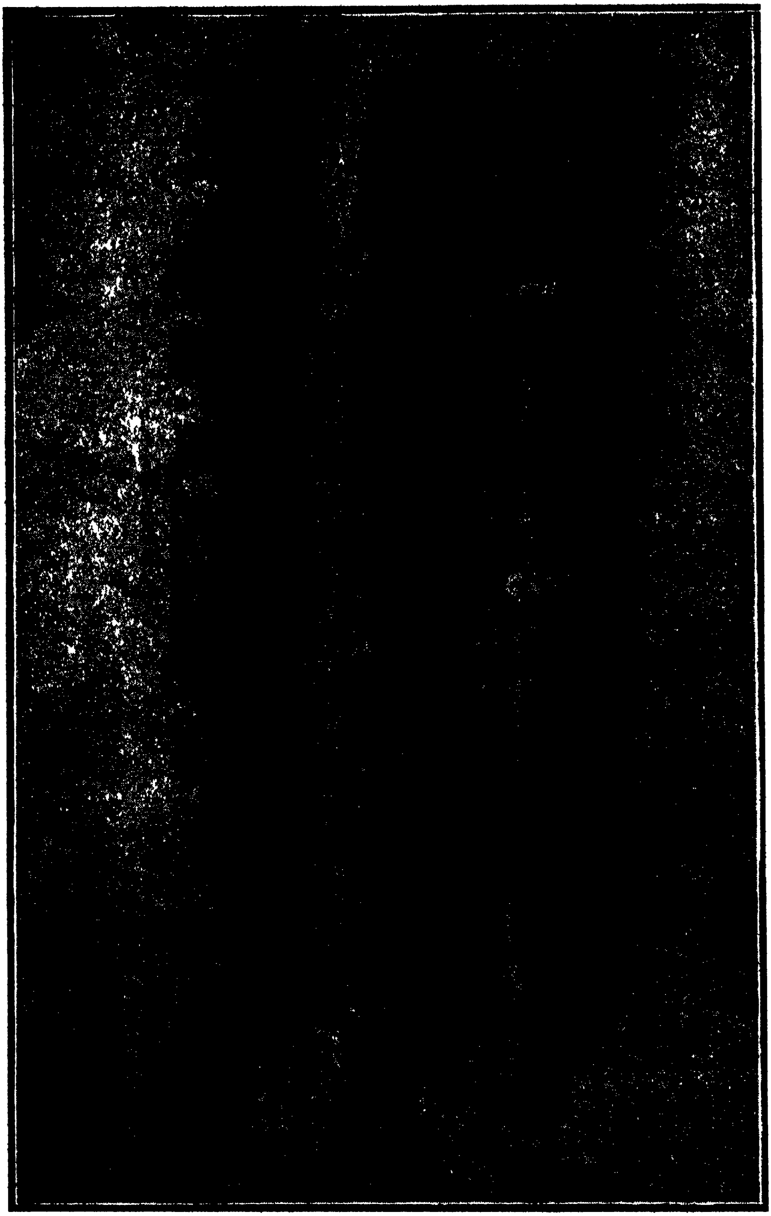

FIG. 16.—1. Java 106 (P. O. J.); 2. Java 213 (P. O. J.); 3. Java 36 (P. O. J.)

three rows of roots. Wax ring narrow and in lower joints thickly covered with wax. Eye channel conspicous in middle joints. Eye narrow, semicircular below, upper part making an angle of a little less than 90 degrees. Germinating point almost apical, nerves fine and numerous. Hair groups 1, 3, 12, 21, 23, and 26 constant, 2, 10, 16, 18 and 19 variable. Inner auricle when present is 1–2 mms. long. Outer auricle 5–10 mms. long, always present. Leaf long, narrow, dark green, callus pale yellowish green.

Appendix C

AN ANNOTATED BIBLIOGRAPHY OF THE P. O J. CANES

Abbreviations—Three journals which are repeatedly quoted in this list are abbreviated therein as follows:

Revista Industrial y Agrícola de Tucumán (Argentina)—*Rev. Tuc.*
Mededeelingen van het Proefstation voor de Java-suikerindustrie—*Med*
International Sugar Journal of London—*I S. J.*

Agee, H. P.

(1) The Propagation of New Cane Varieties from Seed. La. Planter; April, 1911. Mentions, in a detailed review of varietal work at the Audubon Park Expt. Sta., importation of *POJ 234* into Louisiana from Tucumán, (Argentina) Sugar Exp. Sta., but lack of later mention in La. Repts. would indicate that it was never extensively tried out there.

(2) Resistance to Disease and Adverse Agricultural Conditions by Hardy Sugar Cane Types. Rept. of Committee in Charge of Expt. Sta. to Hawaiian Sugar Planters' Assn., Sept. 7,, 1923. Recent collapse of standard sugar-cane varieties in Porto Rico through attacks of Mosaic and root diseases have brought this subject into much prominence. Earle's list of var. more or less immune to root diseases, in which he singles out *POJ 36, 105* and *234* as immune, is referred to. Reference is also made to the rehabilitation of the Argentine sugar industry by the introduction and extension of *POJ 36* and *213* and to the introduction of *POJ 36* into Formosa & *J. 105* into Egypt with striking results.

(3) Resistant Cane Varieties. Rept. to Haw. Sug. Plant. Assn., 24. Mentions introduction into Hawaii from Java of apparently clean seed of *POJ 36, 213* & *234,* inspired by striking results from these canes in Argentina, Porto Rico & Formosa.

Andino, A. M. de, y Colón, Eduardo

(4) Cane Varieties in Northern Porto Rico. Mem. of the Assn. of Sug. Technologists of P. R., I, 1; pp. [illegible] 17th June, 1922. An interesting little review of results with some canes at Central Plazuela.

Arango, Rodolfo

(5) La Enfermedad de las "Rayas Amarillas" o "Mosai en la Caña de Azúcar. La Hacienda, pp. 106–9, Ene., 1921. Quotes some figures, probably erroneously, from Rev. Tuc. on yields of *Uba* compared with *POJ* canes.

Avila, Julio P.

(6) La Caña Azúcar en las Indias Occidentales. Tucumán, Argta.; 1923; pp. 1–98. Historical.

Barber, C. A.

(7) Cane-Breeding in Hawaii. I. S. J., XXVI, pp. 245–9; May, 1924. Review of recent work in Hawaii. "Cane varieties and seedlings raised in Mauritius, Barbados, Java, Demerara and other countries, have been spread all over the world and have in many cases given a fresh impetus to the sugar industry but we nowhere meet with forms of such wide distribution as the old *Bourbon,* which presumably was not a seedling."

Barber, T. C.

(8) Damage to Sugar Cane in Louisiana by the Sugar-Cane Borer. U. S. Bur. Entomology, Circ. 139, p. 12; 1911. Gives numerous analyses of infested and borer-free cane at Audubon Park Experiment Sta. and shows in every case heavy deterioration to manufacturing value of juices due to borer attack and inversion and disease following thereafter.

(9) Trabajos Proyectados con Insectos de la Caña. Rev. Tuc., III, pp. 95–102; agosto, 1912. "In the main and sub-stations a number of foreign varieties of sugar cane are now being tried out . . . . These will be carefully observed . . . with the object of determining if the damage caused by insects varies with distinct varieties and different climatic conditions."

(10) Trabajo de las Subestaciones para 1912–13. Rev. Tuc., III, pp. 142–5; Sept., 1912. Outlines varietal expts. in substations.

Bennett, A. G.

(11) Informe de Subestaciones para el Año 1914. Rev. Tuc., V, pp. 202–19; Oct., 1914. In Monte Bello *POJ 36* yielded 35 tons cane per hect., *213* gave 55½ and *234* yielded 23½ tons in comparison with 15 tons for the *Rayada.* In San Pablo the yields per hectare were, for the *POJ 36,* 59 tons, and for the *213,* 65½ tons, in comparison with the very good yield of 39 tons for the *Rayada.* In this expt. *POJ 234* lead all other varieties (14 in number) in sugar content of juice —19.42%—the *Rayada* showing 16.37%. *POJ 105* yielded 50 tons cane per hect., with 16.37% sucrose in juice and a purity of 81. In Aguilares *POJ 36* lead the 7 varieties tried with 90 tons cane and 7 tons sugar per hect. In Luján *POJ 213* lead with 83 tons cane and 6½ tons sugar, an exceptional yield for that dry section.

BLOUIN, R. E.
(12) Variedades de Caña. Rev. Tuc., II, pp. 73–115; **1911.** Gives results from first crop of *POJ* and some **200** other varieties harvested in the Tucumán Sugar **Expt.** Sta. Lists *POJ 36, 213* and *234* amongst the 20 varieties so far giving superior results to those obtained with the staple cane of the country, the *Rayada.*
(13) Estudio de Nuevas Cañas. Rev. Tuc., II, pp. 214–7; 1911. Letter to Mr. Carlos R. Hamakers, who had offered to secure large quantities of the *POJ* canes for *Tucumán* on a visit to Java, advising against any such wholesale and expensive importation on the basis of such short experience in the Tucumán Sugar Expt. Sta. with these canes.
(14) Informe sobre los Trabajos Efectuados en la Estación Agrícola durante 1912–1913. Rev. Tuc., III, pp. 417–506; 1913. Includes *verbatim ad literatim* Rosenfeld's "Diez de las Cañas Más Prometedoras" (166) and Barber's "Trabajo de las Subestaciones" (10).
(15) Una Comparación de los Resultados de los Ensayos con las Cañas de Java con los de las Cañas "Kavangire", "Zwinga" y Morada y Rayada del País. Rev. Tuc., IV., pp. 141–50; Sept., 1913. Interesting comparison of three years results with these varieties. Classifying results as second ratoons, *POJ 213* and *234* stood at head of list as regards percentage sucrose in juice, *Zwinga* and *Kavangire* (*Uba*) lead *POJ 213* and *36* in yield of cane per acre and *Zwinga* surpassed *POJ 213* in total sugar produced per acre. In fiber content *Uba* lead all varieties with 13.1% and also showed most rapid inversion after cutting — dropped from 83.4% purity to 25.4% in 12 days.
(16) Variedades de Caña. Rev. Tuc., IV, pp. 192–200; Oct., 1913. Gives results of crop of second ratoons, as well as first ratoons, of *POJ* and some 200 other cane varieties. *POJ 213, 36* and *234* stood out prominently in order given.

BLOUIN, R. E., & ROSENFELD, ARTHUR H.
(17) Memoria sobre los Trabajos y Progresos de la Estación Exptl. Rev. Tuc., I, 11, pp. 1–47; Abr., 1911. "Some of these varieties give considerable promise, especially some of the Java seedlings."
(18) *Idem.* II, pp. 423–85; 1912. Contains short discussion of work with varieties for two years.
(19) Informe sobre los Trabajos Efectuados en la Estación Exptl. Agrícola durante 1913–14. Rev. Tuc., IV, pp. 369–481, 1914. Very complete report on Sta. work to date, including list of all articles on varieties published in Rev. Tuc. from the first no. in June, 1910. These

are 10 in number, by Blouin, Zerban, Rosenfeld and Hall. *POJ 36, 213 & 234* show up strikingly well in this rept. in the central station as well as in the sub-stations.

BRANDES, E. W.
(20) The Mosaic Disease of Sugar Cane and Other Grasses. U. S. D. A. Bull. 829, pp. 1–26; Oct., 1919. Discusses resistance of Java varieties. Mentions *POJ 36* as *56*.

CALVINO, EVA MAMELI DE
(21) Estudios Anatómicos y Fisiológicos sobre la Caña de Azúcar en Cuba. Estn. Exptl. Agronómica de Cuba, Bol. 46, p. 5; Abr., 1912. "The Java cane industry subsists only as a result of the new seedlings obtained and selected by its experiment stations. The same is the case in the British West Indies, in Demerara, in Argentine Republic, etc."

CROSS, W. E.
(22) El Contenido de Fibra y el Problema de Combustibles. Rev. Tuc., V, pp. 197–8; Oct., 1914. In a most interesting little note gives fiber content in Tucumán of various *POJ* and other canes and concludes that high fiber content of the former will help to reduce wood consumption in the furnaces of the centrals. "The new varieties which have given the most promise in the Experiment Station as regards tonnage and sugar content have comparatively high fiber contents, being equal in this respect to the very best varieties which are today being widely cultivated in Java and Hawaii."
(23) Algunos Resultados de la Introducción de Variedades Extranjeras. Rev. Tuc., V, pp. 271–3; Nov., 1914. Short review of work of producing and introducing new sugar-canes varieties in various countries, particularly of the work of Kobus, the producer of the *POJ* canes, and the extension of these varieties to other countries.
(24) La Cosecha de las Nuevas Variedades de Caña. Estación Exptl. Agr. de Tucumán (Argentina), Circ. 2, p. 2; Feb. 1916. Calls attention to rapid inversion of *POJ* canes after cutting and advises their very prompt delivery to factory.
(25) Memoria de la Estn. Exptl. Agrícola correspondiente al Año 1915. Rev. Tuc., VI, pp. 463–89; Abr., 1916. Rept. as Acting Dir. in absence of Director Rosenfeld. In regard to varieties says, "A complete rept. on this work was compiled by the Director, Mr. A. H. Rosenfeld, and published in a special no. of the *Revista* . . . As a result of five years of study of the Java canes the conclusion was reached that the *POJ 36* is the best

variety from every standpoint and the cane destined to replace the native (*Rayada*) in the province. The next cane recommended was the *POJ 213*, third choice going to the *POJ 234*."

(26) Un Progreso Epocal en Tucumán. Rev. Tuc., VI, pp. 502–5; Abr., 1916. Considers that successful work of Tucumán Sugar Expt. Sta. with varieties, especially the results from and rapid extension of *POJ 36* and *213*, places Tucumán, in spite of its rather unfavorable climate and subtropical conditions, in a position where its yields of cane and sugar per acre can compare favorably with the averages in countries much more favorably located for cane growing.

(27) Renuncia del Sñor. Arturo H. Rosenfeld. Rev. Tuc., VII, pp. 91–4; Agst., 1916. "The Station's field experiments were under the direct personal charge of Mr. Rosenfeld for many years and he is responsible for the prolific experimentation with the Java seedling canes, which were carefully and exactly studied from every angle before being definitely recommended to the planters of the province . . . It was logical that, as he was the person who had had the most experience with these Java canes and who best understood the most effective and cheapest methods of planting and cultivating them, he should be the technologist called to scientifically direct the large-scale renovation with these seedlings."

(28) El Empleo del Despunte para Plantar. Rev. Tuc., VII, pp. 134–8; Sept., 1916. Gives results of two series of expts. made by Rosenfeld and records starting of a new series along the same line with *POJ* canes.

(29) Repartición de Cañas de Java y Caña Forrajera. Rev. Tuc., VII, pp. 153–9; Sept., 1916. "The remarkable results from the Java canes which have been under the study of this institution for seven years and have been strongly and definitely recommended by the Station . . . . have had as a result the planting on a truly enormous scale of said varieties all over the province."

(30) Programa de las Experiencias Agrícolas a Realizarse desde Agosto, 1916, hasta Agosto, 1917. Rev. Tuc., VII, pp. 265-72; Dic., 1916. Well-laid-out plan of agricultural work for year, with plan of experimental fields including "the careful study of the Java and forage canes as regards their characters of growth and resistance to drought and disease."

(31) Noticias de la Estación. Rev. Tuc., VII, pp. 292–3; Dic., 1916. Reports that Station is continuing importation of promising varieties of cane from all parts of the world. It is thought that results even more successful than those obtained with the Java canes should result

from the continual trying out of new varieties in carefully planned experiments."

(32) Variedades de Caña en la Estación Experimental. Rev. Tuc., VII, pp. 311–25; Ene., 1917. "In the November, 1915, edition of the Rev. Tuc. (III–6) Mr. A. H. Rosenfeld published a detailed study of the results obtained during five years of experimentation with foreign varieties of sugar cane. The object of this publication is to bring up to date the data published on that occasion by Mr. Rosenfeld by adding the figures obtained from the crop of 1916."

(33) Memoria de la Estación Experimental Agrícola correspondiente al Año 1916. Rev. Tuc., VII, pp. 357–89; Feb., 1917. "*Las Cañas de Java.*—The success of the experimental work realized at the Station with these canes and the results of five years of careful study impelled us to definitely recommend them in November, 1915. As is well know, they are now replacing the creole canes in a manner almost without precedent in the history of the world's sugar industry . . . . The Experiment Station can now guarantee the success of the new varieties and of the industry depending upon them."

(34) Algunas notas sobre la Plantación de la Caña de Java. Rev. Tuc., VII, pp. 390–3; Feb., 1917. Cane for planting purposes should be as fresh as possible, particularly seed of *POJ 36, 213* and *234,* which deteriorate very rapidly not only from manufacturing standpoint but in germinating power, after cutting. Irrigation should be given immediately after planting where possible, above all if cane is somewhat dry when planted, and the cane planted deep after good soil preparation. Cane should also be covered as soon as possible after planting. In case of being forced to plant somewhat dry cane it would be highly advisable to increase amount of seed employed per acre.

(35) La Selección de Caña de Azúcar en la Cosecha. Rev. Tuc., pp. 394–8; Feb., 1917. With advent of *POJ* canes in Tucumán province new factors are introduced into cropping routine and author recommends system of sampling cane fields to determine maturity before harvesting each one, these analyses to commence several weeks before crop. "The advantages of such a system of study of cane maturity are many. It places the crop upon a perfectly rational basis, avoids the harvesting of distinctly unripe cane and assures the grinding at he proper time of the most mature fields."

(36) La Inspección de Plantas Importadas. Rev. Tuc., VII, pp. 405–16; Mar., 1917. Letter from Director of the Tucumán Expt. Sta. to the President of the Board of

same calling attention to necessity of a plant-quarantine law for the province. Discusses the replacement of *Rayada* cane by the *POJ* varieties and states that some carelessly imported disease or insect might possibly lead to a decline in the value of the latter canes. Lists dangerous diseases and insects susceptible of easy introduction. In compliance with this indication Governor Padilla decreed a plant-quarantine law on the 30th of March, 1917.

(37) Ensayos Cooperativos. Rev Tuc., VII, pp. 435–42; Mar., 1917. Outlines a series of ten proposed coöperative expts., for the basis of which, in the case of sugar cane expts., the *POJ 36* and *213* are mainly recommended. Expts. include liming, trash burning, early cutting, use of stubble shaver, varieties, fertilization, amt. seed most advisable for use, spacing and rotation of crops.

(38) Plantación de Caña. Rev. Tuc., VII, pp. 446–7; Mar., 1917. Expts. with Java canes indicate that they should be pltd. as soon as possible after cutting, in furrows recently opened, irrigating, where possible, shortly after pltg. No advantage to be gained by stripping the seed before pltg.

(39) Lista de las Variedades de Caña que se Han Ensayado en la Estación Experimental Agrícola. Rev. Tuc., VII, pp. 451–69; 1917. As inquiries are frequently received as to whether this or that variety has ever been tried at Expt. Sta. it has seemed advisable to publish in one article a complete list of all varieties tried at Sta., with brief observations as to results obtained with each. Discusses *POJ 36, 213* & *234* under one heading, observing: "These canes have now come to be the basis of the Tucumán sugar industry, the Creole canes having notably degenerated."

(40) Noticias de la Estación. Rev. Tuc., VIII, pp. 30–3; 1917. Mentions efforts being made by the Tucumán Sta. to obtain flowers of the *POJ* canes under the more tropical conditions of the northern provinces of the Argentine in order to breed Tucumán seedlings from same.

(41) Pp. 78–80; 1917. Describes irrigation expts. with *POJ* canes at Tucumán Sugar Expt. Sta., employing standards worked out in Hawaii as to quantity of water required.

(42) Cañas Prometedoras en la Estación Experimental. Rev. Tuc., VIII, pp. 101–6; 1917. Results from some of the more recently imported canes, as well as from a number of those under trial for several years. Amongst the former figure *POJ 105* (discussed as *Egyptian*

Amber), *L 511*, *BH 10/12*, *Yon Tan San* (possibly our *Java Unknown*) & *D 1135*.

(43) Resultados de Caña Soca del Quinto Año en la Estn. Experimental. Rev. Tuc., VIII, pp. 106–7; 1917. Interesting figures from original plntg. of the *POJ* canes at the Tucumán Sta. As fifth ratoons *POJ 213* yielded 87 tons of cane and almost 10 tons sugar per hect. *POJ 234* gave 47½ tons cane and nearly 5 tons sugar and *POJ 36* showed yields of 45 tons cane and 4 tons sugar.

(44) Tratamiento de la Caña Dañada por las Heladas. Est. Expt. Ag. de Tucumán (Argentina), Circ. 7; July, 1918. Discussion of effect of different degrees of cold on standing cane, particularly on the *POJ* varieties, considering, also, methods of avoiding or reducing frost damage and the handling of deteriorated canes at the factory.

(45) Tratamiento de la Caña Helada—Notas Adicionales I & II. Rev. Tuc., VIII, pp. 270–7; 1918. Further considerations on this subject, particularly as regards procedure in factory, advisability of alcohol distillation of deteriorated juices, use of frozen cane as forage, etc.

(46) La Caña Java 228. Rev. Tuc., VII, pp. 279–82; 1918. After Fawcett's definite decision that the two *POJ* canes cultivated in Tucumán as *139* & *228* were both *POJ 228*, the *POJ 139* having proven a very inferior variety in trials at the Expt. Sta., author publishes results of Rosenfeld's previous expts. with the *POJ 228* in comparison with *36*, *213* & *234*. "It has proven to be an excellent variety which gives good yields of cane and sugar per hectare. It is somewhat late in maturing."

(47) Estudios Relacionados con la Experimentación con la Caña de Azúcar. Universidad de Tucumán, Depto. de Investigaciones Agrícolas, No. 5, pp. 1–109; 1918. A series of six lectures given agricultural students. "After five years of variety work the recommendations of the Station have been limited to four varieties which appear advisable for the manufacture of sugar (*POJ 36*, *213*, *228* & *234*)."

(48) Informe Anual del Año 1917. Rev. Tuc., IX–1, pp. 1–31; 1918. "The replacement of the Creole cane by the Java seedlings, definitely recommended by the Experiment Station in 1915, can now be said to have been concluded. In fact the crop of 1918 will consist largely (more than 90%) of Java canes."

(49) Ensayos sobre Plantación de Cañas Java y Criolla. Rev. Tuc., IX, pp. 48–50; 1918. Results of two very interesting experiments to test effects on *POJ 36* and

on *Rayada* of plantg. seed immediately after cutting and of leaving it for up to 9 days before planting (in Tucumán this system of *amortiguar* seed was once very common). The *POJ 36* from old seed gave less than half the cane and sugar per acre produced by the fresh seed, whereas the *Rayada* results showed no detrimental effects from allowing the seed to dry out for the maximum.

(50) Ensayos sobre Métodos de Impedir la Descomposición de la Caña Helada. Rev. Tuc., IX, pp. 51–6; 1918. Windrowing experiments under Tuc. conditions turned out quite contrary to results obtained in Louisiana practice, the windrowed cane inverting more rapidly in Tucumán than frozen cane left standing. *POJ 36, 213* & *234* used in these expts.

(51) Ensayos con Abonos para la Caña de Azúcar. Rev. Tuc., IX, pp. 72–85; 1918. Reviews Rosenfeld's extensive series of fertilizer investigations with native canes (*Rayada*) and brings up results to date. Gives results of new series started with *POJ 36* & *213*, in which potash and phosphoric acid again failed to show any appreciable effect on yield or analyses, while the increased yield from the use of nitrogenous fertilizers would hardly pay cost of these and application of same. Results from liming also proved negative.

(52) El Problema de la Caña Helada. Rev. Tuc., IX, pp. 102–9; 1918. During crop of 1918 Tucumán suffered most severe frosts of her history, the *Rayada* showing much more severe effects than did the *POJ 36, 213* & *234*, which proved notably resistant—"Much more resistant than one could have expected from any cane. This resistance is of the greatest value for the Province."

(53) Experimentos sobre el Deshoje de la Caña. Rev. Tuc., IX, pp. 110–14; 1918. Reviews work done along line of disproving any value from stripping standing cane in Hawaii and Porto Rico and gives results of an exhaustive series of stripping tests in the Tuc. Agr. Expt. Sta. with *POJ 36, 213, 228* and *234*, which also failed to show any gain in tonnage from this very expensive process.

(54) "Las Cañas de Java" en Java. Rev. Tuc., IX, pp. 152–8; 1919. Study of culture of *POJ 36, 213, 228* and *234* in Java, with tables showing acreage of each of these varieties cultivated on the various Java plantations. In very few centrals are any of these canes [illegible] on a very large scale, *POJ 36* & *213* occupying a maximum of 10% each of the cane area of 8 plantations and only one plantation cultivating *POJ 234* (about 20 acres all told).

(55) Las Cañas Tucumanas en la Cosecha de 1919. Rev. Tuc., IX, pp. 161–7; 1919. First published results from Tucumán seedling canes. "All these thirty are less fibrous than the Java canes now cultivated in the Province. They are also thicker than the latter."

(56) Los Ensayos con Abonos para la Caña de Azúcar. Rev. Tuc., IX, pp. 170–8; 1919. Fertilizer expts. and results with *POJ 36* and *213* in both limed and unlimed soils. Stable manure gave no positive results, nor did sulphate of ammonia show any consistent gains, but both varieties responded readily to green fertilization and crop rotn.

(57) Importante Exportación de Caña de Azúcar. Rev. Tuc., IX, pp. 178–82; 1919. Mentions sending of *POJ 36, 213, 228* & *234* and *Uba* from Tuc. Agr. Expt. Sta. to Porto Rico in 1915 and later sending of 10 tons *Uba.*

(58) La Desfibradora "Searby". Rev. Tuc. IX, pp. 182–4; 1919. Correspondence with Prof. H. P. Agee, Director of the Sugar Planters' Expt. Sta. in Hawaii, *et al.* in regard to probable usefulness of a shredder on the lines of the "Searby", so much used in Hawaii, for easier handling at the mills of high-fiber content canes like *POJ 36.*

(59) "Las Cañas de Java" en Java—Una Corrección. Rev. Tuc., IX, p. 184; 1919. Correcting column "Ks. Cane per Hect." erroneously published in original article (54).

(60) El Deterioro de las Cañas Cortadas. Estn. Exptl. Agric. de Tuc, Circ. 7, pp. 1–3; 1919. "It is a well known fact that the Java canes commonly cultivated in the Prov. undergo a very notable deterioration after being cut if they are not very promptly ground."

(61) Informe Anual del Año 1918. Rev. Tuc., X, pp. 1–30; 1919. "The Java canes are employed as the basis of the field work of the Station (especially the *POJ 36* & *213*), having been long since definitely recommended by the Station and being now the basic canes of the provincial sugar indsty."

(62) El Problema de la Caña no Molida. Rev. Tuc., X, pp. 42–5; 1919. Discusses expts. made by Hall and Rosenfeld in leaving *POJ 36, 213* & *234* without harvesting for two yrs. with good results and no deterioration and gives favorable results of further expts. along this line. "The stools of the *caña dejada* had not suffered any damage whatsoever despite the length of time it stood before crop."

(63) Recientes Resultados con Algunas Variedades de Caña. Rev. Tuc., X, pp. 74–9; 1919. "A variety which has attracted considerable attention in the Province is the *POJ 105,* first introduced under the name of 'Egyp-

tian Amber.' Results obtained and observations carried out indicate that this cane, although quite a promising variety, cannot in any way compare with the *POJ 36* and *213*. Generally it gives smaller agricultural yields than the latter, it is more susceptible to disease and is not of such early maturity as was at first thought."

(64) Distancia a que Debe Plantarse la Caña de Azúcar. Rev.. Tuc., X, pp. 87–100; 1919. "The practical conclusion arrived at from these results, is, therefore, that *POJ 36* & *213* should be planted with the minimum distance between the rows that will permit of implement cultivation. We have found that a distance of 6 ft. allows of easy cultivation with machinery."

(65) La Necesidad de la Rotación de Cultivos. Rev. Tuc., X, pp. 115–24; 1919–20. "The Java canes, even more than the Creole ones, should be rotated, since they produce twice the tonnage given by the indigenous varieties."

(66) El Tratamiento de la Caña Dañada por las Heladas. Rev. Tuc., X, pp. 143–53; 1920. Finds that *POJ 36, 213* & *234* are much more resistant to the effects of frost than *105*.

(67) La Caña Java en Tucumán. Revista Azucarera de Buenos Aires, XVIII, pp. 207–9; July, 1920. Interesting study of Tucumán's 1919 crop, devoted largely to the substitution of the *Rayada* cane with the *POJ 36* & *213*.

(68) Rotación de Cultivos para la Caña de Azúcar. Una Parte Esencial de la Agricultura de la Caña de Java. "Sugar", N. Y., XXII, pp. 683–6; Sept. 1920. "The author desires in this article to call attention to the absolute necessity of adopting, as one of the necessary modifications in cultural methods brought about by the use of the Java canes, the system of crop rotation. Also he may be allowed to state that the Tucumán planters should not object to adopting some such system of agriculture, since the agriculturists of the remotest ages have always recognized such a system as necessary and inevitable."

(69) Informe Anual del Año 1919. Rev. Tuc., XI, pp. 1–44; 1920. "The past year has been the most notable in the history of the Station, since in that period we have seen the absolute justification of the recommendations made by the Station in 1915 (at that time directed by Mr. Rosenfeld) in regard to the substitution of the Creole cane by certain Java varieties. These recommendations have now been carried out all over de Province. The splendid results obtained in

1919 in all parts of the Province constitute the most eloquent justification of our recommendations."

(70) Estudio de la Caña Dejada. Rev. Tuc., XI, pp. 85–99; 1920–*21*. Analyses and studies of *POJ 36, 213 & 234* left for two years before harvesting. "It cannot in any manner be said that chemically or technically the *caña dejada* was not apt for sugar manufacture. On the contrary, it showed high purity, low glucose and good adaptability for the factory."

(71) Un Ejemplo de la Resistencia de las Cañas de Java a las Heladas. Rev. Tuc., XI, pp. 103–5; 1920–21. Demonstration of the remarkable resistance of these canes to frost.

(72) Distancia a que se Debe Plantar la Caña de Azúcar. Rev. Tuc., XI, pp. 118–21; 1921. Expts. with *POJ 36 & 213*. "The selection of the best distance between the rows, therefore, must depend upon the factor of economy; the distance should be selected which gives the cheapest production of cane per ton."

(73) Las Posibilidades de las "Cañas de Java" en Luisiana. Rev. Tuc., XI, pp. 118–21; 1921. Recommends the introduction of these canes into Louisiana and their study under the conditions of that State which are so similar in general to those of Tucumán.

(74) The Java P. O. J. Canes. La. Planter, LXVI, p. 202; 1921. Address before the La. Sugar Planters' Assn. in New Orleans, advising trial of these canes. "We venture to predict success from the use of the Java canes in La."

(75) Ensayos sobre Métodos de Plantar la Caña—I. Rev. Tuc., XII, pp. 65–70; 1921. Gives yields of *POJ 36* planted *en chorro* and according to Reynoso system.

(76) Estudios con Variedades de Cañas Importadas. Rev. Tuc., XII, pp. 72–92; 1921. Interesting data on *POJ 105* and short bibliography of previous publications in Rev. Tuc. on varieties. Also data on *BH 10(12)* and *D 1135*. "The *POJ 105* proves to have some very good characters, but is clearly inferior to *POJ 36 & 213*. We have not been able to confirm its supposed early ripening, of which much was said a few years ago."

(77) Ensayos sobre Métodos de Plantar la Caña—II. Rev. Tuc., XII, pp. 93–8; 1922. Continuation of (75).

(78) Ensayos de Cultivo de Caña con Caupi en las Trochas. Rev. Tuc., pp. 99–102; 1922. Cowpeas in middles had no effect.

(79) Ensayos sobre el Cultivo de la Caña sin Quemar la Maloja. Rev. Tuc., XII, pp. 103–10; 1922. Expts. with *POJ 213*. "The most correct conclusion, as is indi-

cated by the average results from the two expts., is that the cane which did not have the trash burned gave the same yield of cane and sugar per hectare as that of which the trash was burned.''

(80) La Estación Experimental Agrícola de Tucumán—Su Contribución a la Industria Azucarera de Puerto Rico. Rev. Tuc., XIII, pp. 207–11; 1923. Gives history of sending of *Uba* & *POJ 36* from Tucumán Sug. Expt. Sta. to Mayagüez Sta. in 1915 and discusses excellent results obtained.

(81) La Caña del Lote Fundador de la Estación Experimental. Rev. Tuc., XIII, pp. 211–14; 1923. Gives results through 12th-yr. stubble of original plantation of *POJ* canes at Expt. Sta. ''The varieties *POJ 36* & *213* . . . maintained their high yields even in the last years . . . These results demonstrate the long duration of these varieties, *i. e.*, that they can be cropped commercially through many years of ratoons.''

(82) Observaciones sobre la Situación de la Industria Azucarera en Louisiana. Rev. Tuc., XIV, pp. 8–13; 1923. Compares present situation of Louisiana cane industry with situation existing 15 yrs. ago in Tucumán, before the establishment of the Tucumán Sugar Expt. Sta. and the introduction of the *POJ* canes. Disagrees with the Rept. of the Comm. on Agr. Progress to the effect that recent poor crops in La. are due to soil exhaustion and thinks that, just as in Tucumán with the Java canes, larger yields were obtained than ever before. Lousiana ought to work in the same direction by fighting Mosaic Disease and working with resistant or immune varieties.

(83) Experimentos con la Caña Criolla. Rev. Tuc., XIV, pp. 16–19; 1923. Discusses replacement of Creole (*Rayada*) cane in Argentine by *POJ 36* & *213* and expts. once more initiated in 1917 to determine if, by abundant fertilization and best cultivation, selected *Rayada* could be made to compete advantageously with the *POJ* varieties. The expt., as in previous cases, turned out negatively.

(84) El Procedimiento de Quemar la Caña en Cosecha. Rev. Tuc., XIV, pp. 29–36; 1923. Discusses expts. to determine the possibility of substituting burning for usual stripping of varieties with closely adhering leaf-sheaths like *Uba* or *POJ 213*.

(85) Informe sobre Cañas ''Tucumanas'' de Semillero. Rev. Tuc., XIV, pp. 37–49; 1923. ''Some of the varieties may prove tolerant to Mosaic, in the same manner as are the *POJ 36* & *213*.

CROSS, W. E., and BELILE, J. A.
(86) La Deterioración de Cañas Cortadas. Rev. Tuc., V, pp. 277–90; Dic., 1914. An exceptionally profound and completely original study of this problem. Commenced by Hall and brought to successful conclusion by authors. Cane-juice inversion has been attributed to a number of causes by distinct technologists, but this is perhaps the first time that the theory of enzymic inversion has been advanced in this connection—and apparently proven. The question of control of inversion has been carefully investigated by the authors and important experimental data, the basis of much future investigation, was obtained. Authors consider that same enzymic action that is responsible for rapid inversion of *Uba* and *POJ* canes is probably cause of rapid and prolific germination of these varieties.

CROSS, W. E., & FAWCETT, G. L.
(87) La Enfermedad del "Mosaico" en España. Rev. Tuc., XIV, pp. 80–2; 1923. Interesting correspondence with Planidura Carreras, of Barcelona, in regard to outbreak of Mosaic in Spanish canefields. In case of light or localized infection advise rogueing and establishment of isolated seed gardens, whereas if infection is more or less generalized advise use of *Uba* or other immune canes, or such strongly tolerant varieties as *POJ 36* & *213*.

CROSS, W. E. & HARRIS, W. G.
(88) Deterioration de las Cañas de Semillero de Java después de Cortadas. Rev. Tuc., VII, pp. 219–50; Nov., 1916. An extremely studious and valuable contribution to this subject. The authors conclude that (1) *POJ 36, 213* & *234* and *Uba* suffer a very rapid deterioration upon cutting, (2) these canes should be gotten to factory within 48 hrs. after harvesting, (3) *Uba* suffers most rapid inversion of above varieties, (4) aside from loss of sucrose in these canes due to delayed delivery, the loss of weight is an important factor and (5) degree of inversion is largely dependent on climatic conditions.

DEERR, NOEL
(89) Cane Sugar, publisht by Norman Rodger, London, pp. 40–1, 1921. Gives Jeswiet's and Fawcett's descriptions of a number of the *POJ* canes, together with history of their production.

DÍAZ, CARLOS
(90) Poder Calorífico de Algunas Cañas de Azúcar. Universidad de Tucumán (Argentina), Depto. de Investigaciones Agrícolas. No. 7, p. 44; 1918. Emerson calori-

meter tests of frozen *POJ* canes to be used as fuel gave 4,009 calories for *36,* 4,075 for *213* & 4,140 for *234*, determined on a dry basis.

DUREAU, GEORGE

(91) Seedling Canes. Journal des Fabricants de Sucre, Paris, 1916. Reviews a circular of the West Indies Committee giving hist. of seedling production in West Indies and Java and studies work done by Rosenfeld with *POJ* canes in Tucumán Expt. Sta. Agrees with Cross that the introduction into and trial of the Java varieties constituted an epoch-making event in the history of Tucumán Province.

EARLE, F. S.

(92) Recomendaciones sobre el Cultivo de la Caña de Azúcar en Puerto Rico. Estn. Exptl. Insular, Circ. 17, pp. 1–24; 1919. One of the few available publications on cane cultivation on the "Isle of Enchantment."

(93) Varieties of Sugar Cane in Porto Rico. Jour. of Dept. of Agr. & Labor, P. R., III, 2, pp. 15–55; Apr., 1919. Describes *POJ 36* as *J 56, POJ 213* as *J 226* & *POJ 234* as *J 324,* all erroneously.

(94) The Resistance of Cane Varieties to Yellow Stripe or the Mosaic Disease. Ins. Expt. Sta. of P. R., Bull. 19, pp. 1–15; 1919. "The two Java kinds (*36* & *234*), included in the list of selected varieties, are worthy of special mention. They are in no sense immune since they take the disease freely, but they are so tolerant of it or so resistant to its effects that it seems to do them no appreciable damage. Growth is not checked and the foliage is not yellowed, the presence of the disease only being indicated by a faint mottling with different shades of green. No cankers are formed on the canes. These are the two kinds that have come to be planted almost exclusively in the Argentine, where they have replaced the Rayada and the Morada, the kinds formerly planted there."

(95) Eradication as a Means of Control in Sugar-Cane Mosaic or Yellow Stripe. Ins. Expt. Sta. of P. R., Bull. 22, pp. 1–17; 1919. Repts. on one year's highly practical work.

(96) The Year's Experience with Sugar Cane Mosaic or Yellow Stripe Disease. Jour. of the Dept, Agr. of P. R., III, 4, pp. 3–33; Oct., 1919. Gives proper classification of *POJ 36,* which, confused by Deerr's description (erroneous) as green cane, he had previously (93) called *Java 56.*

*(97) Sugar Cane Root Disease. Journ. Dept. Agr. of P. R., IV, 1, pp. 1–27; Jan., 1920. As regards comparative resistance test with 171 varieties at Santa Rita, says

of *POJ 36:* "Ratoons stand perfect, condition, best. Almost equally as resistant to root disease as the *Kavangire* (*Uba*). These make a class apart in their almost complete immunity to root disease and in their great ratooning power. *POJ 105* promises to be equally resistant."

(98) El Mosaico de la Caña o Matizado. Est. Expt. Insular de P. R., Circ. 22, pp. 2–9; Abril, 1920. Discusses resistance of *POJ* canes.

(99) Variedades de Caña. Ins. Expt. Sta., P. R., Circ. 23, pp. 1–12; Abril, 1920. History and description of *POJ 36, 105* (*Egyptian*) & *234.*

(100) Las Variedades de Caña en Puerto Rico. Est. Exp. Insular de P. R., Circ. 33, pp. 16–19; No., 1920. Paper presented before the meeting of the Assn. of P. R. Sugar Technologists in Río Piedras, 17th Nov., 1920. Calls attention to remarkable resistance to Mosaic Disease shown by *POJ 36* & *234.*

(101) Sugar Cane Varieties of Porto Rico. II. Jour. Dept. Agr. of P. R., V, 3, pp. 1–141; 1921. Corrects description of *POJ 36* which he had earlier described as *56* & describes *POJ 105.* Notes *POJ 213* as imported from the Argentine by this Station in 1921, but not tested.

EARLE, F. S., *et al.*

(102) Yellow Stripe Investigations (Progress Report). Jour. Dept. Agr. of P. R., III, 4, pp. 1–150; Oct., 1919. In the first paper in this volume Mr. Earle again calls attention to the tolerance of *POJ 36* & *234* to Mosaic.

EASTERBY, H. T.

(103) 33nd Annl. Rept. of the Bureau of Expt. Stations, Queensland, pp. 1–58; 1922. Mentions *POJ 36* & *213* as recently imported from Java to Bundaberg Station.

FAGALDE, LUIS M.

(104) Memoria del Banco de la Provincia de Tucumán, pp. 46–8; 1917. Estimates no. of hect. cane in Prov. of Tucumán at 75,446, of which *POJ 36, 213* & *234* represent 66,487. Calculates yield of *Creole* (*Rayada*) at 15 tns. per hect. and the *POJ* canes at 50.

(105) *Id.,* 1919, pp. 33–5. "For the crop of 1920 we can calculate that the whole 80,000 hectares in cane in the Province will be replanted with the best Java varieties . . . If a few small plantings of the native canes remain they need not be taken into consideration, as they will not be of sufficient importance to exercise any influence on the general calculations . . . . The 112,289 hectares of *Creole* (*Rayada*) canes which existed in 1914 have now entirely disappeared."

FARNELL, R. G. W.

(106) Scientific Research in Connection with the Sugar Industry. I. S. J., XXVI; pp. 303–7; June, 1924. Paper read before the West Indian Agr. Conference, 30th Jan., 1924. "Mr. Bovell calculates that simply by replacing the White Transparent variety by three of his seedlings the planters (of Barbados) have reaped a direct profit of over £4,000,000 within the last eight years. Similarly in Argentine it has been estimated that by the introduction of Java seedlings the planters of Tucumán are saving £500,000 per annum (in costs of cultivation only). In Java the results have been even more striking."

FAWCETT, G. L.

(107) Producción de Caña de la Semilla. Rev. Tuc., V, pp. 451–2; Mar., 1915. In view of important results obtained in Tuc. with *POJ* seedling canes, points out importance of continued attempts to obtain seedling canes bred under Tucumán conditions, which author eventually succeeded in doing.

(108) Las Enfermedades de las Raíces de la Caña. Rev. Tuc., VI, pp. 37–8; Jun., 1915. Few root diseases occur in Tucumán. Concludes that importance of *Marasmius* has been over-estimated by cane pathologists, although undoubtedly causes occasional trouble. For control of root disease complex recommends planting of resistant varieties such as *POJ 36* and *213*.

(109) Algunas Descripciones Botánicas de las Variedades de Java y Otras Cañas. Rev. Tuc., VI, pp. 509–23; May., 1916. Valuable original descriptions, according to Jeswiet system, of *POJ 234, 36, 213* & *105* (as *Ambar de Egipto*).

(110) La Descripción de Variedades de Caña. Rev. Tuc., VII, pp. 351–3; Ene., 1917. Calls attention to importance of proper description and classification of cane varieties in order to avoid large losses to planters through the planting of inferior canes which look like proven better varieties. Reviews work along this line in Java by Soltwedel, Benecke, Kobus (the originator of the *POJ* canes) and latterly by Jeswiet.

(111) La Identificación de las Variedades de Java y Otras Cañas. Rev. Tuc., VII. pp. 424–31; Mar., 1917. As previous descriptions have seemed complicated to the planters, considers in this article only the simplest and most noticeable characteristics of the varieties.

(112) Algunas Mutaciones Normales y Anormales de la Caña de Azúcar. Rev. Tuc., VIII, pp. 33–40; 1917. Interesting descriptions and cuts of two remarkable mutations of *POJ 36*, with discussion of spot formation in sugar-cane varieties.

(113) Notas. Rev. Tuc., VIII, pp. 81–2; 1917. Discusses recent demonstration of extreme susceptibility of *H 109* to "eye spot" (*Cercospora sacchari* Van Breda de Haan) as an indication of care growers of *POJ* canes in Tucumán should take in reporting any unusual outbreak in their canes.

(114) Hojas Amarillas de Brotes de Caña. Rev. Tuc., VIII, p. 110; 1917. Short note on chlorotic condition of cane leaves, due to defective nutrition. "The *Java POJ 36*, being a variety with light green leaves, shows this chlorotic condition more frequently than the other Java canes."

(115) Algunas Descripciones Autorizadas de Cañas Originales de Java. Rev. Tuc., VIII, pp. 195–214; 1918. Detailed botanical descriptions with cuts, of *POJ 36* & *213*, translated into Spanish from the original Dutch of Dr. Jeswiet. A valuable addition to Spanish literature of subject.

(116) Enfermedades de las Raíces y de las Cepas de la Caña. Rev. Tuc., IX, pp. 97–102; 1918. *POJ 36, 213* & *234*, commonly cultivated in Tucumán, while relatively resistant to root diseases, do suffer to certain extent from their attacks. Considers *POJ 36* most resistant of these three. Advises employment of good cultural methods & rotation of crops from time to time.

(117) Algunas Descripciones Adicionales de Variedades de Caña. Rev. Tuc., IX, pp. 129–52; 1919. Descriptions of *POJ 105* & *234*.

(118) La Obtención de Cañas de Semilla Producida en la Argentina. Rev. Tuc., X, pp. 31–41; 1919. Discusses "the superiority of the canes introduced from Java over those formerly cultivated here" and mentions the plantation of *POJ 36, 213* & *234* made by Rosenfeld in the northern province of Jujuy with the object of obtaining flowers—"the first plantation of cane made by the Expt. Sta. outside of the Province" (of Tucumán). States that the flowers of *POJ 36* & *213* are pollen-sterile, those of *POJ 234* fertile to very small extent and *POJ 105* probably fairly fertile.

(119) La Enfermedad de las Rayas Amarillas en la Caña. Rev. Tuc., X, pp. 46–8; 1919. "In every case the oldest infected leaves of the Java canes possess a dark green color and appear completely sound and normal, not showing the white and yellow areas characteristic of the older infected leaves of other varieties. This fact indicates that the Java canes have a certain degree of resistance to the disease. The yields of the Java canes heavily attacked by Mosaic have been very satisfactory indeed."

(120) Notas Adicionales sobre las Cañas Criollas. Rev. Tuc.,

X, pp. 170–5; 1920. Discusses parentage of female parents of these canes (*Rayada* & *Morada*).

(121) Notas sobre la Extirpación del Mosaico de la Caña. Rev. Tuc., XI. pp. 74–6. 20. "The Java canes fall into the class which does not seem to suffer from the infection."

(122) Las Primeras Investigaciones sobre el Mosaico en Java. Rev. Tuc., XI, pp. 121–3. 1921. Reviews Kobus' early work in Java."

(123) Notas sobre la Clasificación de la Caña Morada Criolla. Rev. Tuc., XII, pp. 125–7; 1922. Shows that purple creole cane of Tucumán is distinct from *Black Cheribón* of Java, parent with *Chunnee* of *POJ 213,* which he states is "perhaps the best variety in the Province."

(124) Enfermedades de la Caña de Azúcar en Tucumán. Rev. Tuc., XIII, pp. 1–46; 1922. Mentions plant of *POJ 36* & *213* as susceptible to top rot & *POJ 234* both as plant and ratoons. *POJ 36* apparently least affected. Considers *POJ 36* also most resistant of Java canes to Mosaic, *POJ 105* in intermediate grade and the *213* most susceptible. All four resistant to root rot. Discusses windrowing expts. with *POJ 36* & *234.*

(125) La Desinfección de la Caña por la Calefacción. Rev. Tuc., XIII, pp. 205–6; 1923. Interesting rept. on results from expts. to determine effect of water at from 48 to 50 deg. C. on Mosaic infection in *POJ 213.* "The procedure, as can be seen, had an entirely negative effect on the Mosaic. The temperature which is capable of destroying the eyes appears to be close to 50 degrees C." X-ray expts. gave negative results also.

(126) El Mosaico de la Caña de Azúcar. Rev. Tuc., XIV, pp. 5–8; 1923. "Some varieties do not seem particularly affected by the disease. The varieties *POJ 213* & *36* . . . are notable in this respect . . . . Despite their heavy infection with Mosaic they are still cultivated with very good results. The majority of the other varieties which have been tried here . . . have proven to possess very little resistance to the disease, for which reason their cultivation has been discontinued."

(127) Algunas Notas sobre el Efecto del Frío sobre las Yemas de la Caña. Rev. Tuc., XIV, pp. 67–73; 1923. An exceptionally interesting and original study of the effect of freezes on the eyes and heart buds of cane, *POJ 213* being used in the expts. with controlled temperatures of various intensities and durations below the freezing point. Concludes that (1) a temperature of around—3 degrees C. is required to kill the mature eyes, (2) the sprouts are less resistant to cold than

mature eyes, 1½ to 2 degrees C. below zero, according to their stage of development, destroying them, and (8) the black color on the interior of the heart bud frequently found after low temperatures is due to prolonged exposure to temperatures somewhat above those required to kill the cane—for example, several hours' exposure to a temp. around 1½ degree below zero Centigrade.

(128) La Enfermedad de las Raíces en la Caña de Azúcar. La Hacienda, Buffalo, N. Y., XIX, 6, pp. 174–5; Jun., 1924. "The planting of sugar cane of the varieties of Java in the infected soils will be found very advantageous."

GARBIN, GEROLAMO

(129) L'Industria dello Zucchero di Canna. Pubblicato per cura della Ditta Cav. Enrico Toniolo, Milano; 1924. Cites use of Java canes in revolutionizing Argentine sugar industry.

GARCÍA, TUBAL C.

(130) El Costo y la Ganancia de Azúcar. Sugar, N. Y., XXV, 8 & 9, pp. 446–7 & 506–7; Aug. & Sept., 1923. A thesis presented to the Faculty of Economic Sciences of the U. of Buenos Aires, in which the author analyses cheaper cost of sugar production in Tucumán, through use of *POJ* seedlings.

GRUNAUER, L.

(131) Algunos Análisis de la Caña de Lules, 1913. Rev. Tuc., V, pp. 53–6; Jul., 1914. A miscellaneous lot of analyses from one of the best cane sections in Tucumán province of some *Java* seedlings, *D 74* and *Rayada* cane.

GUZMÁN, ALFREDO

(132) La Estación Exptl. y su Utilidad. Rev. Tuc., III, pp. 243–7; Nov., 1912. Letter from Pres. of the Board of Tuc. Sugar Expt. Sta. to the Secretary of the Buenos Aires "Sugar Center" calling attention to work of Expt. Sta. "Consider only the results obtained from some of the Java canes and you will recognize that we have a perfect right to feel very optimistic."

(133) La Cuestión Azucarera. "La Nación" de Buenos Aires, 27 Oct., 1916. An interview with the Pres. of the Tuc. Agr. Expt. Sta. Board. "Happily, and thanks to the investigations carried on by the provincial expt. sta. for many years past, varieties have been found and proven which seem to combine all the desired conditions, as regards agricultural as well as industrial yield, and this year the sugar men and planters have intensi-

fied their efforts to such an extent that practically all the cane fields which were in bad condition are now replanted with these varieties."

HALL, J. A.

(134) Los Problemas Azucareros. El Mundo Azucarero, Habana; Sept., 1914. Reviews work of expt. stations of Tucumán, Perú, Jamaica, Cuba and Louisiana, which he had recently had occasion to visit. Speaking of promising results with *POJ* canes in Tucumán, concludes: "The studies and experiments already realized in the Tucumán Expt. Sta. give promise of very shortly reimbursing the sugar manufacturers and planters for all the expense involved in the establishment and maintenance of that institution—and not only reimburse the funds invested but pay a handsome dividend on the investment . . . Such results can be looked upon with justifiable pride by the experts of the Station."

(135) Observaciones acerca de los Efectos de la Brotación Prematura de la Caña de Azúcar. Mundo Azucarero; 1914. Review of work carried on at Tucumán Sugar Expt. Sta. along this line. Gives complete analyses of *POJ 36* & *234* during crop of 1913.

HAMAKERS, CARLOS R.

(136) Plantaciones o Criaderos de Semilla de Caña en la Montaña. Rev. Tuc., III, pp. 257–61; Nov., 1912. Advises the establishment of seed gardens in Tucumán foot hills, similar to those employed in Java, in order to obtain selected cane each season for the plantations of the *POJ* canes then giving such promising results in the Province.

HAYS, W. M.

(137) Informe sobre la Estación Exptl. Agrícola de Tucumán. Rev. Tuc., V, pp. 139–50; Sept., 1914. Reports, as Consulting Technologist to Tucumán Government, on past and future work of Tuc. Sugar Expt. Sta. and its relation to recently founded University of Tucumán. Points out remarkable results already obtained from the *POJ* canes and discusses usefulness of various distinct lines of investigation to the Province. Appends list of 117 projects under investigation at Sta.

JESWIET, J.

(138) Beschrijving der soorten van het Suikerriet. Med., VI, 7 & 8; 1916. Probably the work of most importance to date on technical descriptions of cane varieties, being extensive and detailed. Follows more or less same system of description employed by his predecessors. Soltwedel, Beinecke & Kobus, this being based on

vegetative characteristics of plant cane 4–6 months old or the upper part of mature canes.

(139) Id., No. 12; 1917. Publishes detailed original descriptions of *POJ 36* & *213*, with illustrations. A most useful contribution to literature of this subject.

JOHNSTON, JNO. R.

(140) The Mosaic Disease of Sugar Cane in 1923. Published by the Agr. Research Dept. of the United Fruit Co.; pp. 1–35; Dec., 1923. "*Java 36* (*POJ*) is also highly resistant."

JONES, T. H.

(141) The Sugar-Cane Moth Stalk Borer. Expt. Sta. of Sug. Plan. Assn. of P. R., Bull. 12; March, 1915. Reviews Van Dine's work and adds much additional data. Calculates loss caused to P. R. sugar producers in 1915 by *Diatraea* at 32,700 tons of sugar.

KERR, E. W.

(142) Fiber Content of Sugar Cane. Sugar, N. Y.; 1915. Calls attention to importance of high-fiber canes for furnishing fuel in subtropical countries. Gives analyses of *POJ* canes in Tucumán and comments on high fiber content of all the promising ones. Considers the adoption of these canes a step forward, not only agriculturally but mechanically.

KOBUS, J. D.

(143) Vergelijkende proeven omtrent gelestrepenziekte. Med., No. 12, pp. 319–42; 1908. First practical studies of Mosaic Disease by the man who by means of crosses produced the *POJ* seedlings. Kobus arrived at the conclusion that the disease manifests itself with varying virulence, citing the example of *Java 247* (*B*), which is stunted and weakened by the disease, while *POJ 36* represents the other extreme of high resistance. Often the latter did not seem to undergo any decrease in yield on acct. of Mosaic, although this declaration does not harmonize with a table of yields which he presents in this paper.

(148) Cane Seedlings in Java. I. S. J., XI, p. 314; 1909. Interesting review of seedling work in Java to date.

KOBUS, J. D., *et al.*

(145) La Caña de Java. Rev. Azucarera, Buenos Aires, XIV, pp. 182–4; Sept., 1916. An interesting and almost forgotten little fragment of history of first introduction of the Java seedlings into Tucumán, first suggested to Gov. Luís Nougués by Dr. Kobus while Director of the Expt. Sta. in Java. Extracts from several of Kobus' letters from 1907 to 1909, together with those

from Gov. Nougués, are given. In speaking of this series of canes, Kobus wrote: "We have in our exptl. fields a series of new cane varieties from which I anticipate a considerable increase in Java sugar production."

MAROTTA, F. PEDRO

(146) Observaciones sobre los Experimentos Realizados en la Est. Exptl. Agrícola con Variedades de Caña. Bol. del Ministerio Nacional de Agricultura, Buenos Aires; 1914. Extremely superficial review of the Tucumán variety work.

(147) El Proteccionisma a la Industria Azucarera por la Ley 8877. Bol. del Ministerio Nacl. de Agr., Bs. Aires, XX, 7 & 8; 1916. Comments on importance of Rosenfeld's "Ten Best Canes in Tucumán." (166). "The canes recommended, then, are the *Java POJ 36, 213, 234 & 139*, which give good yields and are early maturers, with the exception of the *139*, which is a bit late. All have good purities and mfg. value."

MAY, D. W.

(148) Rept. of P. R. Agr. Expt. Sta., 1920. Speaks of the *POJ* varieties as partially immune and "making good growth and producing large yields in spite of Mosaic."

NATTA MAGLIONI, JOSÉ V.

(149) Fomento Agrícola del Chaco. Depto. Nacional de Agra., B. Aires; 1917. "The Java varieties are very much in demand in Tucumán and we fear that little seed can be obtained for use outside the province, since they are destined to totally supplant the Creole canes in that province on account of their outstanding good qualities definitely demonstrated experimentally in that sugar region."

NOUGUES HNOS. *et al.*

(150) El Cultivo de Nuevas Variedades de Caña. Revista Azucarera, Buenos Aires; Nov., 1912. Various replies to a questionnaire sent out by the "Buenos Aires Sugar Center" asking for repts. on results of expts. with new varieties. It is interesting to note that only a few centrals replied that they were cultivating any material extension of the *POJ* canes at that time.

PADILLA, ERNESTO E.

(151) Governor's First Message to Tucumán Legislature; April, 1913. Referring to promising results from *POJ* canes in the Agr. Expt. Sta., says: "Results of the experiments indicate that we are at the initiation of a great evolution in our agricultural industry which will increase our yields and greatly reduce the cost of the manufactured product."

(152) Final Message to Legislature; 2nd April, 1917. "Thanks to the foresight of Gov. Nougués in 1908, seconded ably by the initiative of some of our most enterprising citizens, and later by the work of the Expt. Station, it has been possible to largely increase the plantations of the Java varieties, which promise to give yields double those obtained from the *Rayada* cane on the same area."

(153) Debate on Sugar Tariffs. Argentine Cong. Record; 1917. By planting the Java canes the cost of production is considerably reduced, since these canes develop more quickly and require less cultivation and, consequently, less expense than do the other varieties generally cultivated."

(154) La Cuestión Azucarera. Arg. Cong. Record; 11th Aug., 1920. "The Argentine is the only country in the world which, after almost entirely losing its canefields through a grave agricultural crisis, has recovered from such a blow in so short a time. The industry has come to life again through the employment of the Java canes studied in its experiment station, wisely provided by the intelligent intuition of Governor Luis Nougués."

PADILLA, MIGUEL M.

(155) La Crisis del Azúcar. La Prensa, Buenos Aires; 5th Dec., 1916. "As regards the agricultural phase of the problem, the Argentine industry is at present in a state of evolution. When symptoms of degeneration began to be noted in what is known as the *Creole* cane, which is the variety which has always been cultivated in this country, the planters began to replace this old variety by new ones from Java, the agricultural and industrial yields of which have turned out to be about double those of the native cane.

PAIGE, R. L.

(156) The Future of Uba Cane in Porto Rico. Memoirs of the Assn. of Sugar Technologists of P. R.; 17th June, 1922. Mentions *POJ 36* & *105* as promising canes.

(157) Notes on Some Imported Cane Varieties in Porto Rico. Facts about Sugar, XV, p. 420; 1922. Reports a yield from Guánica of 38 tons per acre for first ratoons of *POJ 36* in 1922, with 15.2% sucrose in juice.

PEÑA, SOLANO

(158) Industria Azucarera; Realidades y Esperanzas. Rev. Tuc., III, pp. 534–6; May, 1913. Calls attention to low field yields in Tucumán as compared with other sugar-producing countries and predicts doubling of Tucumán yields as the *Java POJ* canes are extended

over province. This prediction was realized within five years.

PRINSEN-GEERLIGS, H. C.
(159) Cane Sugar and Its Manufacture. Published by Norman Rodger, London, pp. 1–350; 1909. A standard reference work of great value.
(160) Tratado de la Fabricación del Azúcar de Caña. Published by J. H. de Bussey, Amsterdam, pp. 1–337; 1910. Translation of (159) by Dr. Nicolás van Gorkum, Engineer in the service of the General Sugar Society of Spain.
(161) De Rietsuikerindustrie in de Verschillende Landen van Productie. Vol. IV of Handboek ten dienste van de Suikerriet-Cultuur en de Rietsuiker-Fabricage op Java, published by J. H. de Bussey, Amstdm., pp. 1–416; 1911. Historical, technical and statistical review of the world's cane-sugar industry.

REPETTO, DEPUTY
(162) Sugar Debate. Argentine Cong. Recd., 24th Jan., 1917. Quotes Rosenfeld on comparative productivity in Java and Tucumán, giving figures on area of *POJ* canes planted in the latter and time necessary for complete renovation with these of Tucumán cane area.

ROSENFELD, ARTHUR H.
(163) Una Enfermedad de las Raíces de la Caña. Rev. Tuc., I, 9, pp. 18–20; Feb., 1911. Records *Marasmius sacchari* on roots of some *POJ* canes.
(164) El Trabajo de la Estación. Rev. Tuc., I, 9, pp. 44–7; Feb., 1911. "At the present time the Station is experimenting with 211 varieties of sugar cane from Louisiana, Barbados, Cuba, Porto Rico, Demerara, Java, Spain, Brazil, Argentine and other countries."
(165) La Propagación de Nuevas Variedades de Caña de Semilla. Rev. Tuc., III, pp. 53–66; Jul., 1912. Critical review of Agee's paper on this subject before La. Sugar Planters' Assn. on 13th April, 1911.
(166) Diez de las Cañas más Prometedoras que Están Experimentándose en la Estación Experiemntal. Rev. Tuc., III, pp. 109–33; Ago., 1912. Lecture given before the Sarmiento Society in Tucumán. Ranks *POJ 36*, *213* & *234* amongst the ten most promising of the 250-odd varieties tried.
(167) La Caña Java *POJ 228* Rev. Tuc., III, pp. 139–42; Sept., 1912. Critical exptl. comparison of *POJ 228* with *36*, *213* & *234*. "*POJ 228* was inferior in every way to the other varieties—in chemical analysis as well as in yield of cane."
(168) The Most Promising Varieties of Cane under Trial at

the Tucumán Expt. Station. I. S. J., XVI, pp. 12–23; 1914. Contains in English practically the same subject matter as (166).

(169) Las Cañas de Java en la Estación Experimental Agrícola. La Gaceta, Tucumán; May., 1914. Comments on breakage of a mill roll said to have been due to high fiber content of *POJ 234* being ground at time. "It is positively ridiculous to take the attitude that these high-fiber canes cannot be successfully ground in the modern Tucumán centrals . . . The high fiber content of some of these canes does not in any sense constitute an obstacle to their employment . . . In a simple mechanical problem such as this is Tucumán ought to be able to find the same solution which has been encountered by any other sugar country." Gives fiber content of *POJ 36, 213* & *234* and shows that many Java mills grind continuously canes with higher fiber content than any of these.

(170) Maduración de las Cañas Extranjeras. Rev. Tuc., IV, pp. 527–9; 1914. Analyses made in April, 1914, some two months before initiation of crop (corresponding to October in P. R.), showed good stages of maturity for some of the most promising *POJ* canes. *POJ 234* again demonstrated itself a very early maturer with 86% purity and 14% suc. in juice. *POJ 36* showed 80.4% and 13.8%. "The *Java 234* & *36* (*POJ*) seem to possess in high degree the characteristic of early maturity which is so outstanding in our native canes."

(171) Discurso en Reunión de Plantadores, 14 May., 1914, Rev. Tuc., V, pp. 1–4; Jun., 1914. Calls attention to need of caution and patience in variety expts., as well as to positive danger of jumping at conclusions from a few years' results. "This point should be clearly demonstrated by the fact that, almost without exception, the new varieties of cane which gave us the most promising results the first year of their trial are not today, after four years of careful and accurate investigation from every standpoint, ... those we can recommend for replacing the native canes."

(172) Las Cañas de Java y su Contenido de Sacarosa. Rev. Tuc., V, pp. 199–207; Oct., 1914. Various comparative analyses of *POJ 36, 213*, & *234* with native canes in Tucumán during 1914 crop. *POJ 234* appears in one analysis from Expt. Sta. with 20% sucrose in juice and in another from San Pablo with 19½%. "The analyses of the Java canes have turned out relatively as good as those of the canes of the country."

(173) Ensayos con Abonos durante Cuatro Años. Rev. Tuc., V, 8, pp. 323–61; Jan., 1915. Uniformly negative results from comm. fertilizer applications to *Rayada* cane

indicate that Mosaic Disease has so weakened cane that it does not respond to fertilization.

(174) Memoria de la Estación Exptl. Correspondiente al Año 1914. Rev. Tuc., V, pp. 415–37; Mar., 1915. Short review of work of Station with varieties, especially the *POJ canes,* during year.

(175) Resultados de Cinco Años de Experimentación con Variedades de Caña. Rev. Tuc., VI, 6, pp. 231–78; Nov., 1915. "*POJ 36,* on account of the characteristics already discussed, appears to be the cane destined to replace the *Creole* (*Rayada*) cane in our Province, the *POJ 213* & *234* . . . . following in the order of their mention."

(176) Plan del Campo Experimental. Estn. Exptl. Agr. de Tuc., Circ. Especial; 1915–16. Notes on various expts. with *POJ* canes and diagram of exptl. plats.

(177) Maduración de las Cañas Extranjeras. Rev. Tuc., VI, 434–6; Mar., 1916. Analyses of *POJ 36, 213* & *234* made latter part of April, 1916. "The analyses . . . show . . . very respectable percentages of sugar in the juices of these varieties which we now know to be of early maturity and enable us to predict for the coming crop at least normal purities."

(178) Identificación de las Cañas de Java. Rev. Tuc., VI, p. 437; Mar., 1916. Planters who desire to propagate *POJ 36, 213* & *234* should be certain that seed they obtain is of these varieties and if in doubt should send specimens to Expt. Sta. for identification.

(179) La Caña Kavangire. La Gaceta, Tucumán; 15 Abril, 1916. Calls atention to confusion amongst certain planters in identification of *Kavangire* (*Uba*) & *POJ 234.* "The planter who purchases *Uba* thinking that he is obaining *POJ 234,* paying the price demanded for the latter, is losing money."

(180) La Estación Experimental Agrícola de Tucumán en el Centenario de la Independencia Argentina. Rev. Tuc., VII, pp. 1–82; 1916. "The value of these investigations has been recognized both within and without the country, not the least important of these being those which have enabled the Station to recommend to the planters a series of cane varieties which give far superior results to those commonly employed, as well as the best methods of planting, seed selection, cultivation, etc."

(181) Some Epoch-Making Experiments in the Argentine: The Java Canes in Tucumán. Sugar, N. Y.; Dec., 1917. Discussion of results with Java seedlings in Tucumán and their bearing on the Argentine sugar industry.

(182) Some Remarks on the Tucumán Sugar Industry. Published by American Commercial Club, Buenos Aires;

Dec., 1918. An address before the Comm. Club, covering more or less same ground as (181).

(183) Estudios Gráficos de las Diversas Variedades de Java en las Colonias de Santa Ana. Rev. Tuc., X, 2, pp. 57–8; 1919. "According to yield and analyses there is little to choose between the *36* and *213*, the former probably being preferable only on account of its erect growth, small amount of lodging and easier stripping."

(184) La Estación Experimental de Tucumán; Retrospecto de sus Trabajos. Revista Azucarera, Buenos Aires, XVII, pp. 305–9; Oct., 1919. "In the present crop 90% of the cane ground in the Province is of the Java varieties."

(185) What the Tucumán Expt. Station has Done for the Argentine Sugar Industry. I. S. J., XXI, pp. 488–93; 1919. Covers in English largely the same ground as (184).

(186) Some notes on the Tucumán Sugar Industry. I. S. J., XXI, pp. 606–8; 1919. Brief description of climate and short history of sugar industry in that Province up to the time of the replacement of the commonly grown canes by the *POJ*.

(187) Kavangire—Porto Rico's Mosaic-Resisting Cane. I. S. J., XXII, pp. 26–33; 1910. Considers that thinness of *Uba* and *POJ* varieties does not constitute an insuperable objection to their adoption. "The thin, rapid-growing, but not at all aestherically appearing *POJ 36* & *213* . . . have been universally adopted in Tucumán, only a few rows of native cane being seen today, carefully guarded and nursed as an invalid might be by the friends of his youth."

(188) La Caña Kavangire en Tucumán y Puerto Rico. Rev. Azucarera. Buenos Aires, XVIII, pp. 146–8; May, 1920. Contains in Spanish practically same subject-matter as (187).

(189) The Argentine Sugar Industry. I. S. J., XXII, pp. 388–94; July, 1920. Mentions tremendous impulse given Arg. sugar industry by *POJ 36* & *213*.

(190) Power Cultivation of Sugar Cane. I. S. J., XXII, pp. 499–501; Sept., 1920. Tractor cultivation of *POJ 36* & *213*, with a number of cuts of methods and machinery employed.

(191) The Question of the Distance between Cane Rows. I. S. J., XXII, pp. 558–65 & 629–35; Oct. & Nov., 1920. A rather detailed study of results obtained in various parts of the world, including those obtained at the Tucumán Expt. Sta. with native canes and with *POJ* ones later employed as basis of experimentation.

(192) The Java Canes in Tucumán. I. S. J., XXII, pp. 681–3; Dec., 1920. Gives results obtained at Ingenio Santa

Ana with *POJ 36* & *213* on very large scale, these results covering over a thousand acres.

(193) The Question of the Distance Between Cane Rows. I. S. J., XXIV, pp. 72–6; 1922. Bringing (191) up to date.

(194) Lo que la Estación Exptl. de Tucumán ha Hecho por la Industria Azucarera. La Hacienda, Buffalo, pp. 291–6; Oct., 1922. History of the work of the Tucumán Station with varieties and calculations of money value of the substitution of the native canes in that Province by the *POJ* varieties recommended by the Station.

(195) La Caña Kavangire. La Hacienda, Buffalo, pp. 131–4 & 169–72; May & Jun., 1923. Stresses point that, just as high fiber content of *POJ* canes in Tucumán did not prevent their universal adoption there, this factor should not weigh too heavily in the balance against the use of *Uba* cane in Porto Rico.

(196) A Beneficial Aspect of the Sugar-Cane Mosaic Disease. I. S. J., XXVI, pp. 191–5; Apr., 1924. "In the heaviest-infected districts along the west and northwest coast (of P. R.) . . . the tolerant *POJ 36, 105* and *213* are being employed on a large scale with most promising results."

(197) Aspecto Beneficioso del Matizado de la Caña de Azúcar. La Crónica Comercial y Financiera de Cuba, I, 5, pp. 7–9; May 1924. Spanish translation by C. A. Figueroa of (196).

ROSENFELD, ARTHUR H., & BARBER, T. C.

(198) Trabajos de las Sub-Estaciones, 1912–13. Rev. Tuc., IV, pp. 495–514; 1914. At San Pablo *POJ 36* gave 113½ tons of cane per hectare and the *POJ* 213 yielded 95½. At Monte Bello *POJ 36* gave 85 tons and the *POJ 213* 75 tons per hect. In Manantial third ratoons of *POJ 213* yielded 106 tons p. hect.

(199) El Gusano Chupador de la Caña de Azúcar. Rev. Tuc., IV, pp. 229–366; 1913–14. "The moth-borer (*Diatraea*) can be considerably reduced in its damage . . . by gradually substituting the harder and thinner varieties of cane . . . such as some of the Java canes in which borer infestation is always low."

SÁNCHEZ, JULIO

(200) Informe del Agrónomo Regional. Ministerio Nacional de Agricultura; 1917. Rept. on visit to Centrals "Esperanza" & "Ledesma" in the Prov. of Jujuy, considerably north of Tucumán. From "Esperanza" cites following yields of cane per hect.: *Rayada* 37½; *POJ 36 & 213,* 90; *POJ 234,* 75. Recommends similar trials at "Ledesma".

(201) Informe del Agrónomo Regional al Min. Nacl. de Agra., Buenos Aires. Industria Azucarera, Bs. Aires, XXIX, 365, p. 153; 1924. Regional Agronomist for the Northern Province of Jujuy reports that cane now grown in that province consists 'almost entirely of Java canes.''

SIMOIS, DOMINGO L.
(202) Sobre la Caña Tucumana. Argentine Cong. Rec.; 1917. During debate on sugar tariff Senator Padilla of Tucumán quoted from tlgm. from Director Simois, of the National Sugar School in Tucumán, to Sen. Camaño, as follows: ''We recommend . . . the cropping . . . of . . . large extensions of Java cane . . . We have been able to establish yields of 100 tons per hectare.''

SMITH, ERWIN F.
(203) Bacteria in Relation to Plant Diseases, Vol. III, p. 72; 1914. Mentions stimulus of Sereh ravages to production of *POJ* seedlings.

SNYDER, W. P.
(204) Report of Assistant in Plant Breeding. Rept. P. R. Agr. Expt. Sta. for 1919. Repts. germ. of seed from *POJ 36* & *234* as very poor and the damage caused by ''abundant'' occurrence of Mosaic on *POJ 36* as ''slight'' & *POJ 234* as ''very serious.''

SNYDER & SALDAÑA
(205) Report of the Assistant in Plant Breeding & Horticulture. Rept. of the P. R. Agr. Expt. Sta. for 1921, pp. 16–18; Sept. 1922. The only mention found anywhere of seedlings of *POJ 36*, which is generally found infertile.

STEVENSON, J. A.
(206) The Mottling or Yellow-Stripe Disease of Sugar Cane. Jour. Dept. Agr. of P. R., III, 3, pp. 3–76; July, 1919. Mentions letter from Fawcett reporting resistance of the *POJ* varieties. Refers erroneously to *POJ 36* as *J 856*.

TEMPANY, H. A.
(207) Experiments with Varieties of Sugar Cane, 1920–22, Together with a Summary of Results from 1917 to 1922. Mauritius Dept. Agr., Bull. 30, Gen. Ser.; 1924. As results of expts. with both plants and ratoons during this period, the following varieties are picked out as more or less suitable for cult. on some scale: *D 109, B 6308, B 6450, POJ 213* and 12 local varieties.

TERAN, JUAN B.
(208) La Universidad y la Vida. Lectures of the Rector of the Univ. of Tucumán collected in book form, pp. 1–50;

1921. "We have had in Tucumán some very eloquent experience as to the significance of technical work in Agriculture which serves as a basis with which to gauge its vast possibilities; 3,500 acres of new varieties (*POJ 36, 213 & 234*) of proven canes will in four or five years more entirely take the place of the old varieties. This transformation will probably signify the cutting in half of the cost of our raw sugar material."

VAN DINE, D. L.

(209) Damage to Sugar-Cane Juice by the Moth Stalk-Borer. P. R. Sug. Planters' Expt. Sta., Circ. 1, pp. 1–11; 1912. Estimates direct loss in sugar per acre from reduced value of juice due to borer attacks at 670 lbs. per acre for P. R.

WALE, J. H.

(210) Los Efectos de las Recientes Heladas sobre la Caña de Java. Rev. Tuc., VI, p. 12; Jun., 1915. "It has always been recognized that the Java canes *POJ 36, 213, & 234* are more resistant to the effects of frosts than are the native canes."

(211) Informe de las Subestaciones, Año 1915. Rev. Tuc., VI, pp. 279–96; Dic., 1915. In Monte Bello the second ratoon crop showed 8 tons cane per hect. for the *Rayada*, 61 tons for *POJ 36*, 53½ tons for *POJ 213* & 33 tons for *POJ 234*. In San Pablo as second ratoons the *Rayada* gave 40 tons; the *POJ 36* gave 101, the *POJ 105* gave 69 tons, the *POJ 213* gave 70 tons and the *POJ 234* gave 69 tons. The *POJ 105*, however, showed but 8.69% sucrose in juice, while the *POJ 234*, giving the same field yield, analyzed 14.26%. In Aguilares *POJ 213* showed up best of *POJ* varieties tried as first ratoons with 74 tons cane and almost 3 tons sugar per hectare in a very unfavorable year.

WESTERKAMP, J. F.

(21) Las Cañas Extranjeras en Jujuy. Rev. Tuc., V, pp. 103–5; Ago., 1914. Two interesting letters giving data on an exptl. pltg. of *POJ 36, 213 & 234* at Ingenio Esperanza in the northern province of Jujuy, Argentine. "These canes possess the valuable characteristic of very rapid growth even with a small amount of irrigation water and appear to be well adapted to the drier lands."

WILBRINK & LEDEBOUR

(213) Bijdrage tot de Kennis van der Gelestrepenziekte. Med., No. 39, pp. 433–95; 1910. Interesting statement that seedlings obtained from seed-heads of infected canes are clean.

ERBAN, F.
(214) Advertencia Respecto a la Importación de Nuevas Variedades de Caña. Rev. Tuc., I, 1, pp. 16–7; Jun., 1910. Mentions early introduction of *POJ* canes into Tucumán & calls attention to danger of introducing pests and diseases if importations are not properly inspected by competent authorities.

ERBAN, F., & ROSENFELD, ARTHUR H.
(215) ¿Cómo puede mejorarse la Producción y Calidad de la Caña? Rev. Tuc., I, 3 & 4, pp. 1–16; Ago. & Sept., 1910. Discuss early production of seedling canes in Barbados and Java.

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By

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HELMINTHOSPORIUM LEAF SPOT OF SUGAR CANE IN PORTO RICO

(Preliminary Paper)

MELVILLE T. COOK

Soon after the arrival of the writer in Porto Rico (July 1923) his attention was called to two extremely interesting leaf-spot diseases of the sugar cane. One which was temporarily designated as the "Manatí disease" because it was first found in the vicinity of Manatí, but which has since been found in other localities along the eastern half of the north coast. The other was temporarily designated as the "Santa Rita disease" because it was found on and in the vicinity of the Santa Rita plantation near Guánica. No well marked cases of this disease have been found in other places. A study of these diseases indicated that they are both caused by *Helminthosporium sacchari* Butler or by closely related varieties or species of *Helminthosporium*. These diseases may be described as follows:

MANATÍ DISEASE

This disease starts as very small reddish, occasionally black spots. If red, a black center develops very quickly. The spot becomes very much elongated but usually remains narrow. The center is surrounded by a yellowish zone which may be light green or almost white. These colors grade or blend into each other and vary greatly in relative amounts. Some of the spots remain red until one-fourth inch in length before showing the black center. Any one of the three colors may predominate. When the spots grow old, they usually develop ashy colored centers. They vary greatly in length from one-four inch to 3 inches or more. Occasionally they form reddish or dark reddish stripes extending from base to tip of leaf but these are probably the results of the unions of two or more spots. In the young spots the colors are usually bright and clear but as the spots grow old the colors become dull

and gradually disappear with the dying of the leaf. The spots may appear on any part of the leaf from midrib to margin but do not occur on the midrib. They are much less severe on the sheath than on the blade. In severe cases the entire leaf with exception of the midrib is practically covered with these spots. The result is the death of the infected parts of the leaves and a checking of the growth of the plant. This disease is most severe during or immediately following periods of heavy rainfall and in extremely severe cases the crop looks brown and almost dead. The disease is most severe on D–109 but what appears to be the same thing occurs in a much less severe form on B–3412, D–117, D–433, FC–214, FC–306, PR–260, PR–412, PR–430, PR–561, SC–12(4).

The sporophores are in clusters of from four to twenty, unbranched, 3–10 septate, dark green to brown or black, only slightly geniculate, 25 to 115 × 5 microns, spore slightly curved, 5 to 11 septate, 45–110 × 12 microns. (Figures 1 and 2.)

SANTA RITA DISEASE

This disease starts with minute reddish spots. As they increase in size they may occasionally assume the same characters as those of the Manatí disease but usually are wider, blunt with very pronounced red color which gradually becomes more or less purple. In more advanced stages the spots are larger and irregular in shape. This irregularity is apparently the result of the union of both old and young spots. The result is that the spots become very large and irregular in shape and sometimes include small spots of green, apparently healthy tissues. They may now be more appropriately called blotches. The color varies from red to dark purple, the latter color predominating. The surrounding tissue is usually pale yellow. The amount of purple blotch increases until it is far in excess of the green on the lower half of the leaf. The upper or outer half of the leaf shows very little or no spotting but with the advancement of the disease on the lower half, it becomes yellow and ashy brown. The sheath is finally attacked but not until the disease is well advanced on the blade. The result is a checking of the growth of the cane. This disease is very severe. Severe forms of the disease have not been found in any other place than at Santa Rita nor on any other variety than [illegible] ([illegible]). However, milder forms of the disease have been found on other varieties in that vicinity.

The sporophores are in clusters of from 3 to 6, unbranched,

6–10 septate, dark green to brown or black, straight or geniculate, bearing a single spore at each bend, 60–300 $\times$ 12–14 microns, spores slightly curved, 4–10 septate, 30–95 $\times$ 12–15 microns. (Figs. 4 and 5.)

The characters of the fungus in both cases are those of the genus *Helminthosporium.* There was a severe outbreak of the "Manatí disease" during the early part of the summer of 1923, but at the time of the arrival of the writer, it was rather inconspicuous. However, the Santa Rita disease was very prominent. The first studies revealed such a small number of spores as to be very unsatisfactory. Later, it was found that if leaves on which the diseases were well advanced were collected and kept in a moist chamber from 24 to 48 hours spores would be produced in very great abundance. However, they were easily detached and it was not always easy to find them in abundance.

Helminthosporium sacchari Butler has been reported from various parts of the Island by Johnston and Stevenson. This species was described by Butler from India in 1913 [1] as follows:

"The infected leaves first show small red spots, which spread rapidly, chiefly in a longitudinal direction and, especially toward the tip of the leaf, may run together to form long streaks. The centre of the spot soon changes to a dirty straw color, around which the margin remains red for a time and then changes to dark brown. The spots occur equally on the midrib, where they may be confused with those caused by the leaf form of *Colletotrichum falcatum* and on the thinner part of the leaf. When numerous, they cause death of the leaf tissues beyond the limits of the spots; the tip of the leaf often withers completely and there may be long withered strips down the margins.

"The sporophores are stout, erect, rather rigid hyphae, which arise from the peripheral cells of the stromata. They are usually unbranched, 3 to 10 septate, dark greenish-brown below, paler above and several times bent or 'geniculate'. Spores are produced at each bend and at the apex, the lowest being the first formed and the bent condition being due to the spores being always apical at first and being then pushed to one side by continued growth of the sporophore from just below the insertion of the spore. The sporophores are 100 to 190 microns long, by 5.5 to 7.5 microns broad.

"The spores are borne singly and readily fall off. They are cylindrical or long elliptical in shape, with very thick walls, and divided into from 4 to 11 compartments by broad thick partitions. The color varies from olive green to brown and the size from 35 to 60 microns long, by 8.5 to 12 microns broad.

"*Helminthosporium Sacchari* Butl. n. sp. Maculis amphigenis, elongatis, initio rubris, dein avellaneis, vel straminais ac ferrugineo-marginatis, 3–25 $\times$ 2–6 mm.; caestiputulis minutis, atris; hyphis fertilibus erectis, simplicibus,

[1] Butler, E J, and Kahn, A. H. Some new Sugar-Cane Diseases. Memoirs of the Department of Agriculture in India (Botanical Series) Vol. VI, No. 6.

[2] Butler, E. J., and A. Hafiz Kahn. Red Rot of Sugar Cane. Memoirs of the Department of Agriculture in India, Bot. Ser., Vol. VI, No. 5, 1913.

septatis, geniculatis, olivaceo-brunneos, apice pallidioribus, 100–190 × 5.5–7.5 microns; conidiis amrogenis, cylindriaceis vel oblongo-ellipticis, utrinque rotundatis, 3–10 septatis, crassissime tunicatis, olivaceo-brunneis, 35–60 × 8.5–12 microns."

Butler's description of the spot is very brief and unsatisfactory but a comparison of the measurements of the sporophores and spores as given by Butler with the two forms in Porto Rico shows that the sporophores of the Manatí fungus are smaller than those of *H. sacchari* while those of the Santa Rita fungus are larger. The spores of both the Porto Rican forms tend to run somewhat larger than the spores of *H. sacchari*. The writer judging from both spots and causal organism believes that the Manatí form is more nearly like *H. sacchari*.

J. Van Breda de Haan [1] described a *Cercospora sacchari* from Java producing an "eye-spot" disease, as follows:

"Hab. in foliis, quae maculatur, Sacchari officinarum. Hyphae pluriseptate, brunnae, 120–60; conidia 60–80 × 9–12; vernicularia 5–8 septate brunae."

The complete literature on this disease is not available for the writer. However, Cobb [2] gives a colored plate of this disease which is strikingly similar to the Manatí disease; but spores figured by Cobb are evidently those of *Helminthosporium*. Butler in commenting on the above facts says that "it appears probably that this fungus is really a *Helminthosporium*."

Johnston and Stevenson [3] made *C. sacchari* a synonym of *H. sacchari* and described it as follows:

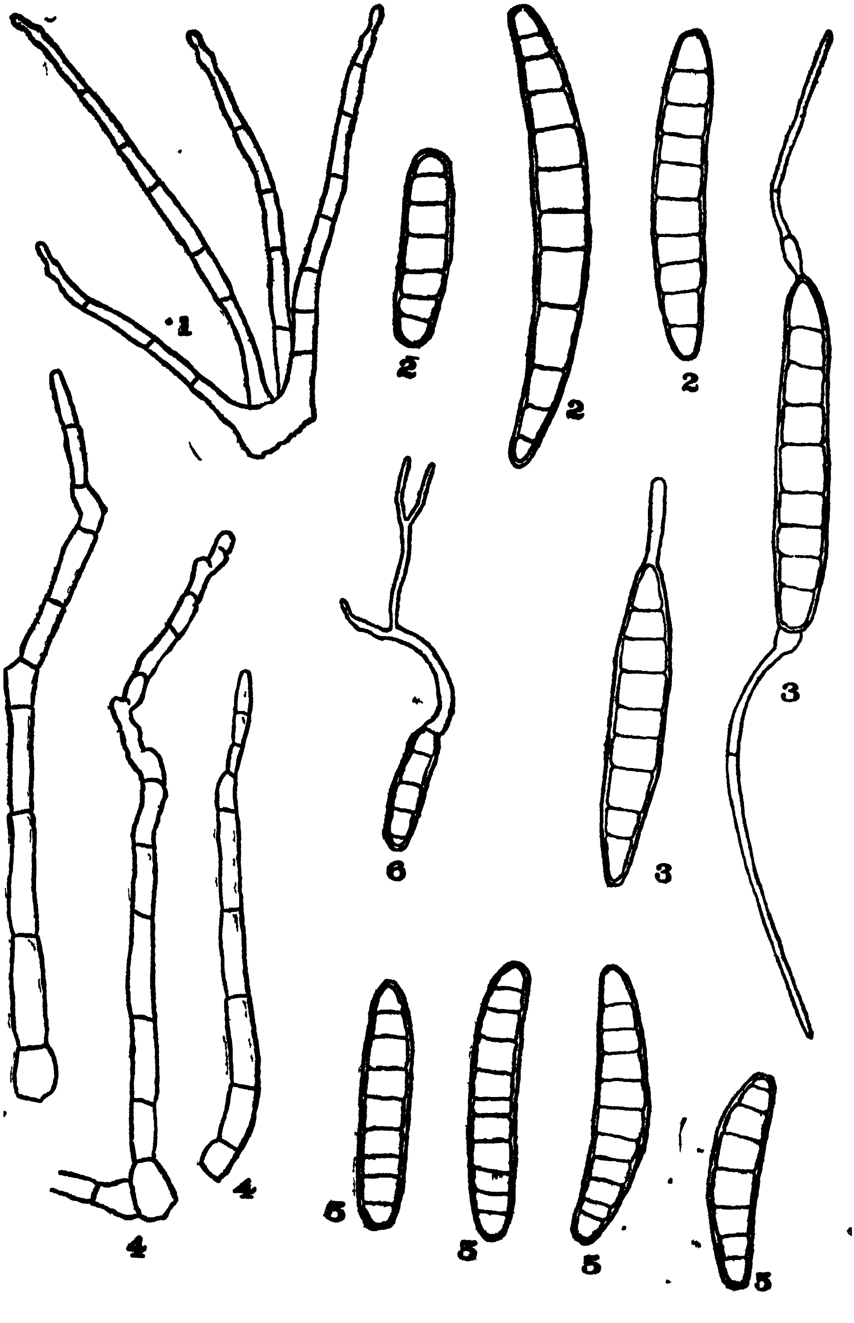
"Hyphae dark, cobwebby, arising from the center of an elongated brown spot on the leaf blade; sporophores more or less erect with single terminal spores; spores several septate with very thick walls, rounded at both ends, 32–90 × 9–14 microns, on conidiophores 120–160 mm. long."

The measurements given by them are more nearly like those of the Manatí than of the Santa Rita form. Judging from the studies up to this time, it appears (1) that *H. sacchari* in Porto Rico is subject to considerable variations which may be due to local conditions or to varieties of host plants or to unknown causes; (2) that the Manatí form is the same or a closely related species and the Santa Rita form is a variety or possibly a new species. How-

[1] Breda de Haan, J. Van. Root Rot en anders Ziekten en het' Zuikerriet, Meded. van Proefstation, West Java, XVI, 1892.

[2] Cobb, N. A. Fungus Maladies of the Sugar Cane. Report of work of the Experiment Station of the Hawaiian Sugar Planter's Association. Bul. 6, 1909. (Division of Pathology and Physiology, Plate IV.)

[3] Johnston, John R., and Stevenson, John A. Sugar-Cane Fungi and Diseases of Porto Rico. Journal of the Dept. of Agriculture of P. R., 1: 177–251 (1917). (See page 208.)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ever, it may be that the "Santa Rita disease" as described may be due in part to other causes.

The spores of both the Porto Rican forms germinate very readily in water, and so far as observed always from the apical cells (Figures No. 3 and 6). When a suspension of spores in water is applied to the young leaves or when pieces of diseased leaves are set in the axils of the young leaves and kept moist the diseases are transmitted very readily. It is important to keep the plants wet. The young leaves contract the disease much more readily than the old ones. Minute spots may be seen by careful examination within 36 hours after infection. Spots are very distinct within 3 or 4 days.

Thus far inoculation experiments have been carried on with but two varieties, the D-109 on which the Manatí disease is most common and most severe and the B. H. 10 (12), the only variety on which the Santa Rita disease is important. Both varieties are easily infected with either fungus and in the young stages it is difficult to separate them, but as they advance in age the characters become more prominent.

Our studies on these two prominent diseases and also on *Helminthosporium* spots from other parts of the Island indicate that *H. sacchari* Butler is subject to great variations or that we may possibly have more than one species. The variations may be due to variations in climate in different parts of the Island or to the varieties of sugar cane which have been developed in such great abundance during the past few years. These and other leaf spots of the sugar cane are of very great importance. In fact they may rank second to the mosaic but it is doubtful if the growers fully realize the extent of the losses due to them. The control will probably lie in the selection of resistant varieties.

This paper is preliminary to a more extensive study of these and other leaf spots of the sugar cane with special reference to the taxonomic relationships of the causal organisms; the influences of environment on them and the relative resistance of sugar-cane varieties to these various diseases.

Explanation of Plate

Fig. 1.—Sporophores from the Manatí form.
Fig. 2.—Spores from the Manatí form.
Fig. 3.—Germinating spores from the Manatí form.
Fig. 4.—Sporophores from Santa Rita form.
Fig. 5.—Spores from Santa Rita form.
Fig. 6.—Germinating spores from Santa Rita form.

A METHOD IN MICRO-TECHNIQUE

By Melville T. Cook

It has long been recognized that in the preparation of many kinds of pathological plant tissue for microscopical study, the causal bacteria or the spores of the causal fungus are usually lost in the fixing, dehydrating or other processes. Therefore, the preparation usually shows nothing but the tissues of the host and some of the fungus mycelium. The writer presents a method which may be of value to his fellow workers. By this method it is possible to retain bacteria, spores of *Colletotrichum, Gloeosporium,* the rusts and many other fungi in position.

The method consists in covering the surface with a very thin layer of agar made up at the rate of 15 or 20 grams to the 1,000 cc. of water. The agar should be heated to the melting point, poured over the surface of the material, then drained off and allowed to harden. Cut the material into pieces of the proper size and drop into the fixing fluid.

In the use of this method the following points must be taken into consideration:

(1) A hard agar is more satisfactory than a soft agar.

(2) Allow the agar to harden thoroughly before cutting.

(3) A thin layer is more satisfactory than a thick layer. A thick layer frequently separates from the material, carrying some of the spores with it.

(4) Cut with a sharp knife, so as not to break the film of agar from the surface of the material.

(5) There must always be one or more freshly cut surfaces to permit the entrance of the killing fluid. These fluids do not penetrate the agar.

(6) The pieces of material should be small, so as to permit quick penetration.

(7) The heating of the paraffine will not melt the agar.

(8) Cultures grown in petri dishes may be killed and fixed by this method by pouring a thin layer of agar on the surface. Very small pieces should be used for fixing.

The writer has used this method for some time with excellent results in the study of plant tissues infected with bacteria, and a number of parasitic fungi. The method has not been found satisfactory with *Cercospora* and only fairly satisfactory with *Septoria.*

COCONUT FALL

(Preliminary Paper)

MELVILLE T. COOK

In December of 1923 the attention of the writer was called to the falling of nuts and leaves from coconut palms. The section in which this disease was discovered contained a very large number of trees and in some places the majority of them were infected.

The symptoms were: (1) A drooping of the lower leaves which was due to a black decay at the base of the petioles. These leaves drop prematurely.

(2) A premature dropping of the nuts in various stages of growth from the very smallest up to those that were practically mature. All these nuts showed a black discoloration at the base. In some cases this blackened area became dry after the dropping of the nuts, while in other cases it developed into a soft rot. This variation was undoubtedly due to the dry or wet condition. In case the disease did not attack the nuts until they were practically mature, the husk only was infected and there was no loss. In those cases in which the young nuts were infected, they fell before maturity and the losses were very heavy.

(3) The infection was less on the tall than on the low trees.

This disease was never observed to kill a tree but loss of nuts was alarming and the drooping of the lower leaves was very unsightly.

An examination of the infected areas showed an exceptionally large amount of litter consisting of old leaves, husks and nuts in various stages of decay.

A study of the diseased nuts showed a very general infection with *Thielaviopsis paradoxa* (De Syner v. Hohn). In many cases pure cultures were secured direct. A study of the litter showed a very general and very heavy infection with this same fungus.

A few months later our attention was called to two isolated trees which were almost ready to bear fruit. These trees were not making a satisfactory growth; the new leaves were not fully expanded and were very much crumpled. These trees were cut and examined. In the first one a very large amount of decay was found in the center of the trunk but none in any other part. The cultures were overrun with saprophytes and very unsatisfactory for study. In

the second there was a small streak of decay from the top to the base of the tree. Cultures from this decay gave abundant growth of *T. paradoxa* but it was impossible to determine whether the infection was primary or secondary. This fungus was reported in the 1912 Annual Report of the Porto Rico Agricultural Experiment Station at Mayagüez as attacking the leaves of the coconut palm but no mention was made of its attacking the nuts. It has also been reported from Jamaica as the cause of a disease of the coconut known as "leaf-bitten," but the symptoms are entirely different from those of the disease found here. It has also been reported from Ceylon (Crics. and Agric. Journ. Royal Botanical Garden, Ceylon. 4 [1909] No. 22 S. Sundararaman on "The Coconut-Bleeding Disease." Bul. 127. Agricultural Research Institute, Pusa) as causing bleeding and decay of the trunks of the coconut palm, but no such condition here has come to our attention. It has also been reported from Florida as the cause of a trunk decay (H. R. Fulton. Phytopothology 12: 398–399, 1922). This fungus is also the cause of a root and stem rot of sugar cane and a fruit rot of the pineapple. In some parts of the world it reduces the germination of the sugar cane. It not only causes a rotting of pineapple fruits but frequently attacks and kills the slips after setting.

Inoculation from pure cultures of this fungus was made on trees in the Station grounds where there was no evidence of the disease. These inoculations were made by drenching the inflorescence and young nuts with water to make conditions as nearly as possible like those following rainfall. Spore of the fungus from pure culture were mixed in water in an ordinary atomizer and sprayed on the inflorescence and young nuts. This was done about 4 o'clock in the afternoon. In a few days we had a very general infection and falling of nuts from the smallest up to those about one-fourth grown. The symptoms were typical and the organism was very easily recovered from these nuts. No effort was made to disinfect these trees, but the disease disappeared in a very short time indicating that it was controlled largely by natural conditions.

The moist litter in the plantations furnishes ideal conditions for the growing of this fungus and the spores are produced in great abundance and readily carried by wind currents. The greater infection on the low rather than on the tall trees indicates that the greatest source of infection probably comes from the litter on the ground and that the spores of the fungus are carried up by wind currents. However, the reduced infection in the tall trees may be

partly due to the drying influence of the sun which would naturally make conditions unfavorable for infection.

An examination of several groves showed that the disease was most prevalent in the presence of moisture and litter. The disease was not found in the interior and in only a few places along the coast.

We did not carry on any work for the control of this disease but recommended a very general cleaning up of all litter in the plantations, and a removal of the diseased leaves and nuts so far as possible. This treatment was carried out and in some places the ground has been plowed. The reports indicate that the disease has practically disappeared.

The writer was assisted in his work by Mr. R. A. Toro and by Mr. J. A. B. Nolla.

A BACTERIAL WILT OF COSMOS

(Preliminary Paper)

MELVILLE T. COOK

This disease appears in the Cosmos plants of any age and has proved very destructive at the Insular Experiment Station and in flower gardens in this vicinity. The foliage wilts and finally turns black. If the bark is removed from the stem just above the surface of the ground, the tissues between the bark and the wood are found to be brown or black. These discolorations may extend to a considerable distance into the branches and the roots. A microscopic examination of a cross section of the discolored part shows an abundance of bacteria and sometimes a fungus in the tracheary tubes. Cultures almost invariably developed a bacterium and a fusarium. Inoculation with these two organisms proved that the bacteria was the cause of the disease.

On potato agar the organism starts slowly but produces a heavy white or almost clear growth within two days.

The growth on oat-meal agar is less than on potato.

The growth on Cooks No. II agar is heavier than on the potato and is slightly tinted yellow. There is considerable gas formation on the third day.

A BACTERIAL WILT OF EGGPLANTS

(Preliminary Paper)

MELVILLE T. COOK

A wilting of the eggplants at the Insular Experiment Station is the cause of heavy losses. Specimens of this disease have been sent to us from other parts of the Island.

The disease does not attack the plants until they begin blooming and fruiting but, when a plant is attacked the disease progresses very rapidly. The first evidence of the disease is a wilting and drying of the lower leaves, followed by a gradual wilting of all the leaves, those at the top wilting last. The leaves are often dry before they have lost all their green color. They finally become brown. If the bark on the stem is removed at the surface of the ground a black zone is found between the bark and the hard wood. This blackening of the tissues can be traced for a considerable distance into the roots and branches, especially in the severe cases. A microscopic examination of a cross section of this blackened tissue shows that the tracheary tubes are filled with bacteria.

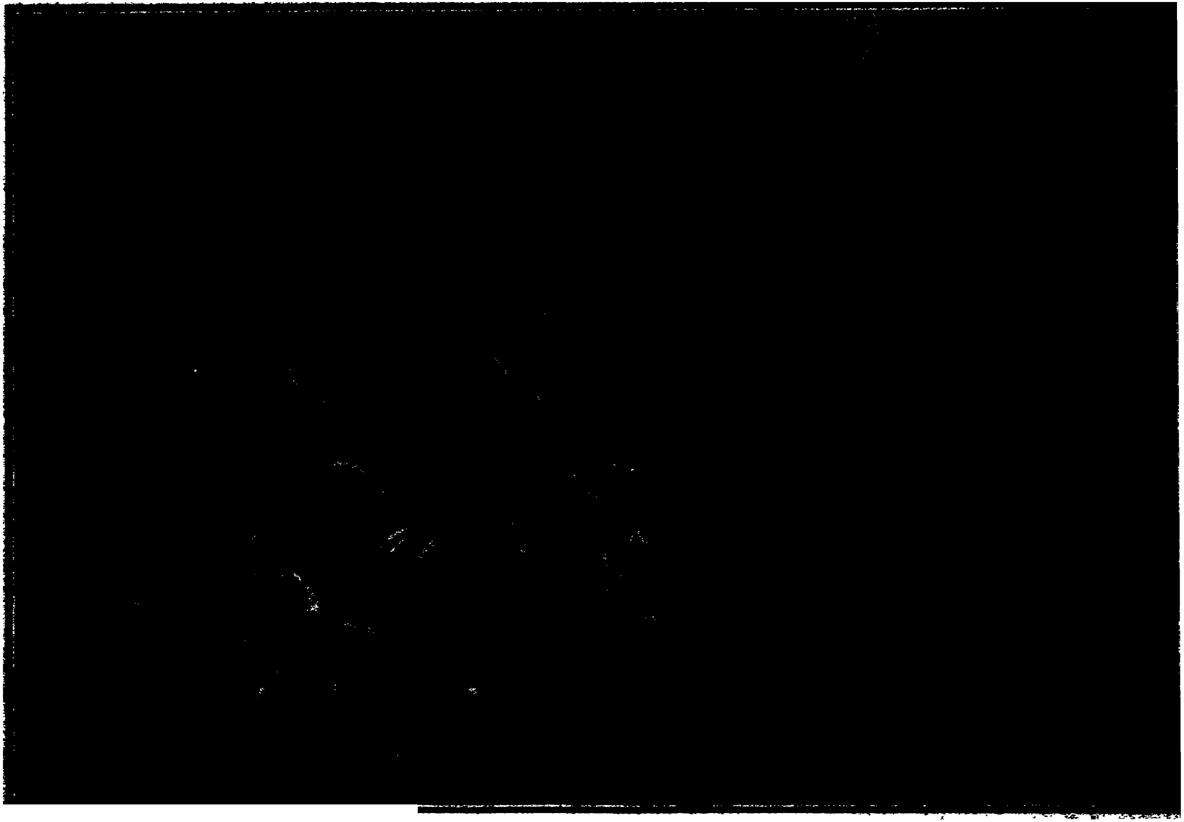
The bacteria are very easily isolated and grown in culture. In fact, most of the cultures are pure. This organism was inoculated into plants of various ages by means of punctures into the stem just below the surface of the ground. These punctures were covered by a pad of cotton and proper checks made. Regardless of the ages of the plants inoculated, there was no evidence of the disease in any of them until they commenced blooming or bearing fruit, when they developed the symptoms previously described. Tomato, pepper and tobacco plants were inoculated with this organism and grown along side the inoculated eggplants, but did not develop the disease.

This disease occurs on every crop planted in our truck crop plots but not in crops planted in soil not previously used for eggplants, which indicates that the organism persists in the soil.

The growth on potato agar was heavy, white, slightly tinted with yellow on the second day with a tendency to liquify the agar and form a gas.

The growth on Cooks No. II was almost equally good, white, tinted with yellow and tendency to form gas.

The growth on oatmeal was slight and tinted with yellow.



Diseased and Healthy Eggplants